POWER

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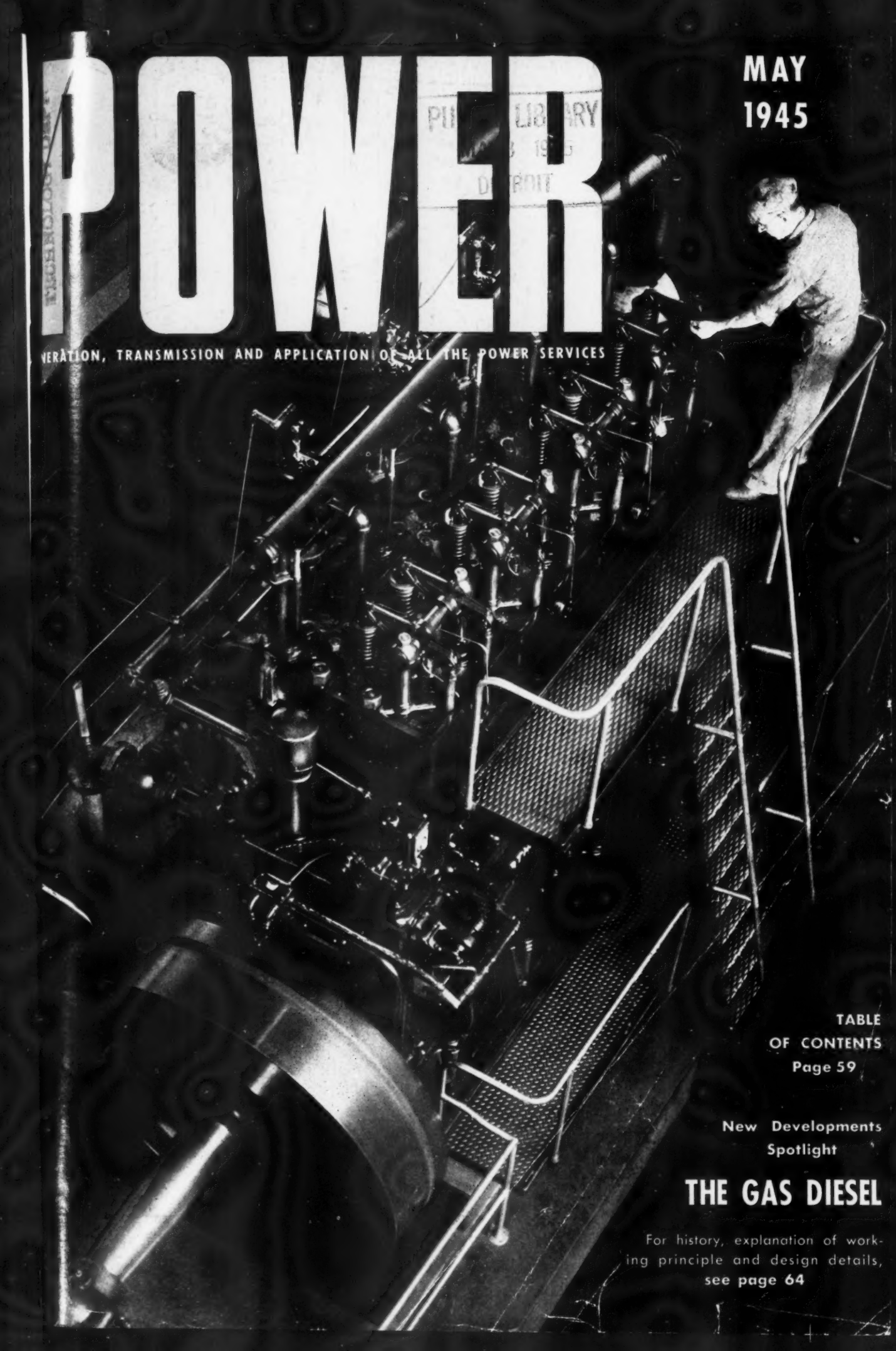
ENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES



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Spotlight

THE GAS DIESEL

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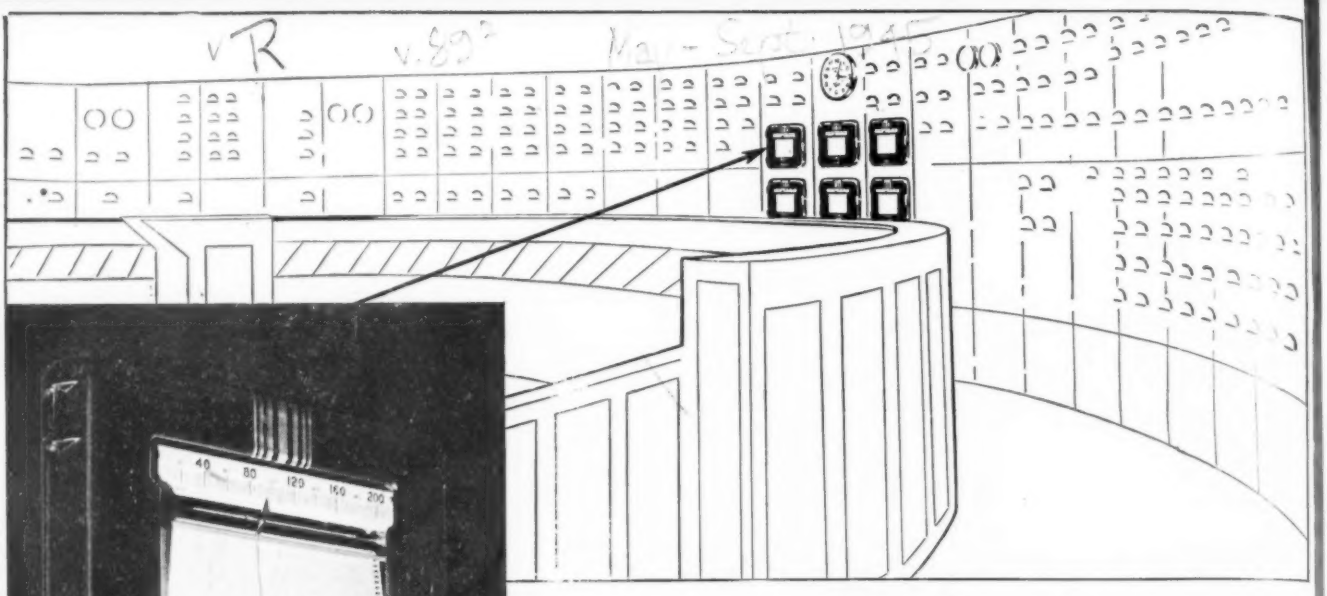
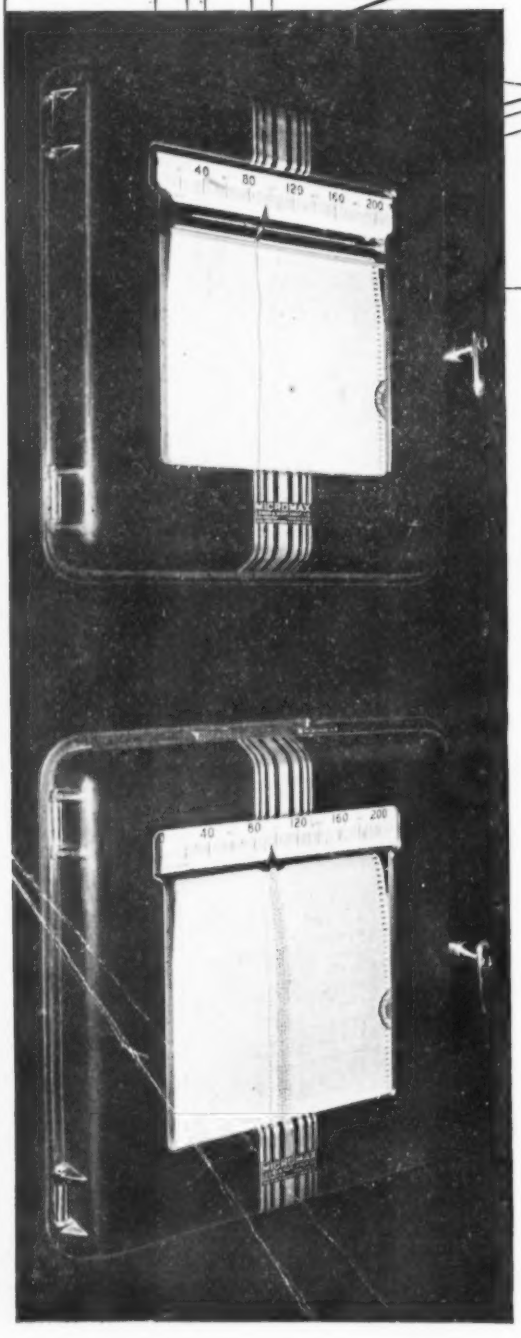
VR v.89 May-Sept. 1945





The Record of a Micromax Helps With Overloads

When war work causes big generators to approach an overloaded condition (as many now do) the operating engineers are finding a new use for the Micromax Recorders of stator and rotor temperatures. They are watching temperature as never before, because it is temperature which eventually limits the load piled on a machine. When a change in power factor or ambient temperature permits a load increase, the stator and rotor temperatures are watched to say . . . how much!

Because a generator's field may change in temperature more rapidly than does the stator, the Micromax Field Temperature Recorder is sometimes a more sensitive guide than the Stator Recorder, especially under conditions of poor power factor. When a difference exists, it is accentuated by the fact that the Field Recorder is a single-point instrument, giving a continuous record of the temperature of the entire rotating mass of copper, whereas the Stator Recorder measures 8 points, so that none is continuous. For this reason, the Field Recorder may be more frequently consulted in routine operation.

The fact that the stator temperature does move more deliberately, however, makes many engineers prefer it as an operating guide, and complete protection against overheating requires that both field and stator recorders be the "insurance policy". They are equipped for signal lights and horn or bell, and stand always ready to give overall protection to generators, whether they be heavily loaded or overheated by accident.

Both of these Micromax Recorders are described in Catalog N-33-161, "Micromax Temperature Instruments for Electric Power Equipment", which is sent on request.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

ARMY-NAVY "E" — *depends on me!*

A Slogan For Every American

Ad N-33-161(6)

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), May, 1945, Vol. 89, No. 5. Published monthly with an additional Directory number in December, McGraw-Hill Publishing Company, Inc. Publications office, 99-129 North Broadway, Albany 1, N. Y. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Please indicate position and company connection on all subscription orders. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year. $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 16 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

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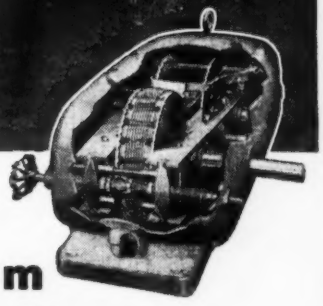
Says the Engineer:

"W' Sure SPLIT HAIRS with this one!"

Right: Boiler room in the plant of the Whiting Corporation, showing two of three pulverizer units feeding powdered coal to boilers. Link-Belt P.I.V. gear speed variators enable the engineer to adjust the feed to meet fluctuating demands for steam. Regulation is instantaneous and precise to a minute-fraction of a revolution per minute. Efficiency and economy of the plant is "immensely improved" since installation, states the engineer.



Sensitive Combustion Control to Meet Varying Demand for Steam Achieved with Link-Belt P.I.V. Gear!

Close-up view of drive regulator on Whiting Pulverizer, Motor removed, showing Link-Belt P.I.V. gear, set in position. Separate control wheel, connected to P.I.V. by roller chain, is also geared to large indicator dial.

To regulate the feed of powdered coal to boilers, in exact relation to load demands, pulverizers built by Whiting Corporation rely on Link-Belt P.I.V. speed variators. With this all-metal, positive and efficient device, the feed can be set instantly at any point, over a wide range.

Designers, builders and users of industrial machinery find P.I.V. gear units save power, time and material by giving quick, accurate timing of machines and processes. Data book 1874 gives full details and engineering data. Write for a copy, today!

LINK-BELT COMPANY

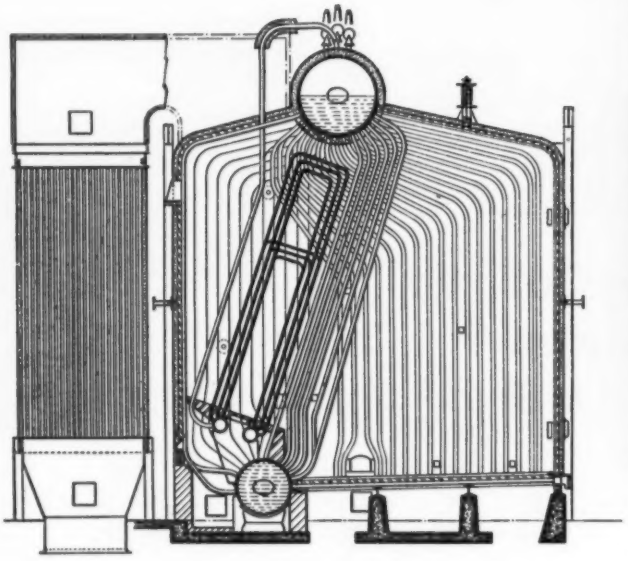
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and distributors in principal cities. 6012

LINK-BELT P.I.V. GEAR

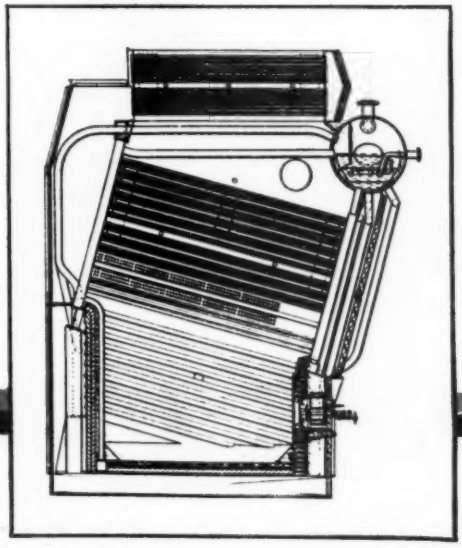
POSITIVE INFINITELY VARIABLE SPEED CONTROL

STEAM FOR

Installation of B&W Integral Furnace Boilers at Fontana Steel Plant.



AT KAISER COMPANY STEEL PLANT—B&W Integral-Furnace Boiler—capacity 160,000 lb. steam per hr. Two units of this size and one of 105,000 lb. capacity supply superheated steam at 475 psi, 700—750 F.



. . . ON KAISER-BUILT SHIPS, TOO
B&W Single-Pass, Header-Type Marine Boiler—a design used on many Kaiser-built ships.

FONTANA...

Power house at Kaiser steel plant, Fontana, Cal.

...another job for B&W Integral Furnace Boilers

At the Kaiser Company's Fontana steel plant . . . where steel plate is produced for Kaiser-built ships . . . B&W Boilers provide all steam requirements for coke plant turbines and by-product processes, blast furnace turbo-blowers, and other mill services.

Speeding steel plate production for ship-building demands a steam supply of highest dependability . . . and the Fontana furnaces and ovens are getting it—economically—from three B&W Integral Furnace Boilers. These boilers are equipped with multi-fuel burners, enabling them to burn blast-furnace gas, coke-oven gas or oil, with provision for pulverized coal firing. Also at this plant, two B&W Gas-Tube Boilers are putting "waste heat" to work, producing low-cost by-product steam for open hearth operations.

This modern plant joins a long list of steel mills, chemical plants, refineries, ordnance and aircraft plants in which B&W Boilers have proved dependable in war production as in pre-war services.

Behind the application of these and other B&W Boilers is more than 60 years of experience which B&W engineers are always glad to share with power engineers.

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
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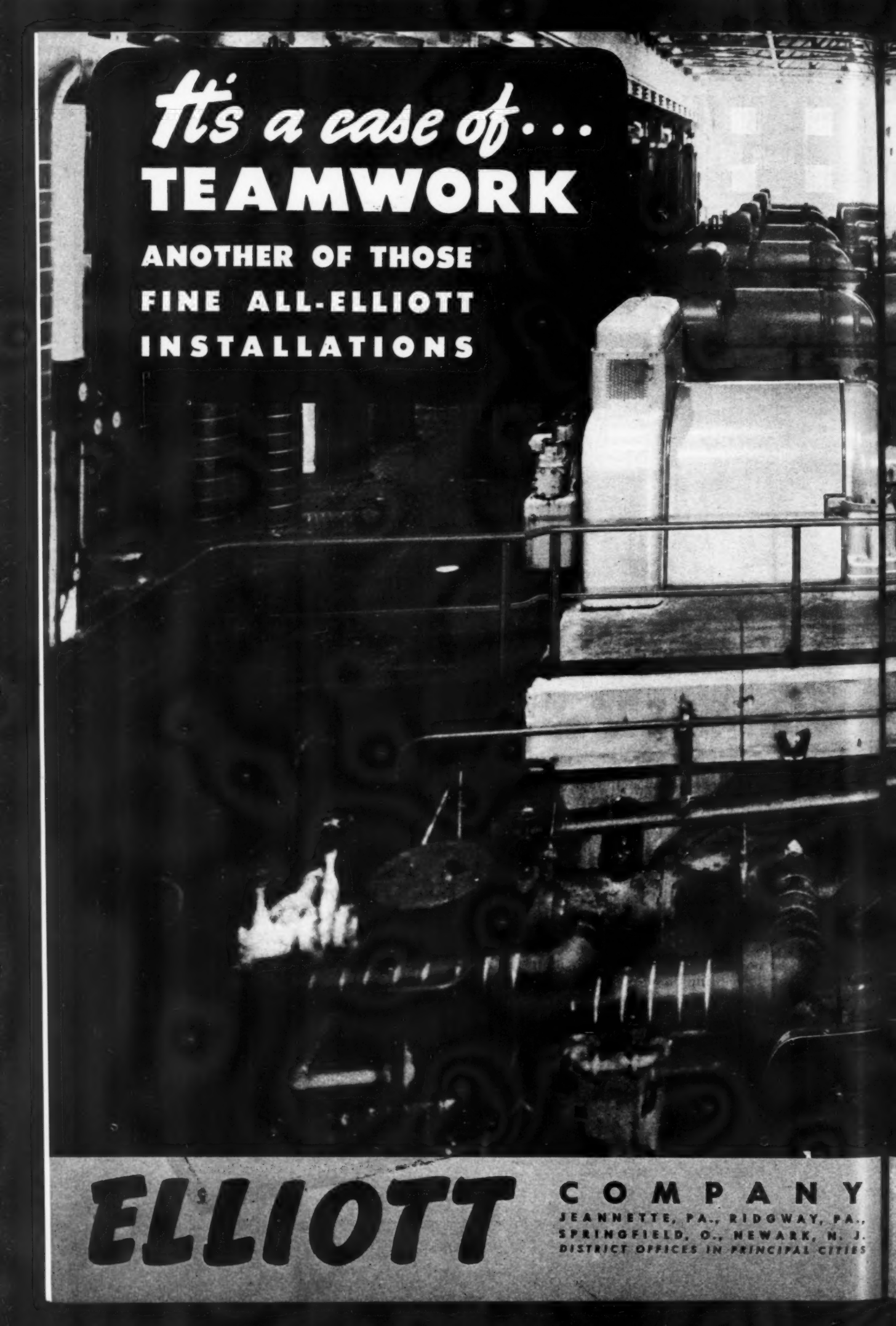
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FINE ALL-ELLIOTT
INSTALLATIONS
ELLIOTT
COMPANY
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We may not tell you much about the plant, nor where it is—there's a war on. Just another case where vital wartime power needs are being supplied by a line of rugged, smooth-operating Elliott turbine-generator units, each served by its Elliott surface condenser.

In an installation like this, highest operating results can be taken for granted. It's a case of team-work. The Elliott units are actually designed together, built together, and when installed each clicks into its proper place without modification or compromise. Plants like these are a source of pride to their builders, and of gratification to their operating executives.

H-693

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
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DIAMOND

AUTOMATIC SEQUENTIAL

SOOT BLOWERS

Correct Boiler Cleaning Assured and Labor Saved

When a boiler is equipped with a Diamond Automatic Sequential Soot Blower System, all blowers operate in proper sequence and at the right blowing speed. No blower can be overlooked or incorrectly operated by a careless attendant. The automatic operation saves considerable labor cost because it entirely eliminates the need for an operator.

The program panel shown at the right controls both retracting and nonretracting blowers (using air or steam or both as the cleaning medium) arranged in groups. One "start" button controls all groups for the entire boiler, superheater, economizer and air heater. Any group can be operated independently of other groups by simply throwing a switch on the panel. Blowing sequence of the units in any group can also be easily altered to suit changed conditions.

Air Offers Additional Advantages

While the saving in labor and improved boiler cleaning are characteristics of all Diamond Automatic Sequential Soot Blower Systems, those using compressed air as the cleaning medium have the additional advantage of eliminating feed water makeup. This is particularly important where makeup water is a problem. Compressed air has a greater density than steam and therefore provides better cleaning. Experience gained during several years' operation proves that maintenance costs are unusually low and that air cleaning used only 1/3 to 2/3 of the energy from the coal pile that is needed for steam blowing. The soot blower piping insulation is eliminated when air is used for cleaning.

Diamond Automatic Sequential Soot Blower Systems have been in very successful central station use on boilers as large as 900,000 lb/hr units since 1940. Write for further information.

This program panel controls both fixed and retracting blowers (using both air and steam as cleaning medium) arranged in three groups; any desired number of groups can be had when system is designed. All soot blowers are operated in correct sequence and at right blowing speed by simply pushing "start" button.

DIAMOND POWER SPECIALTY CORP.

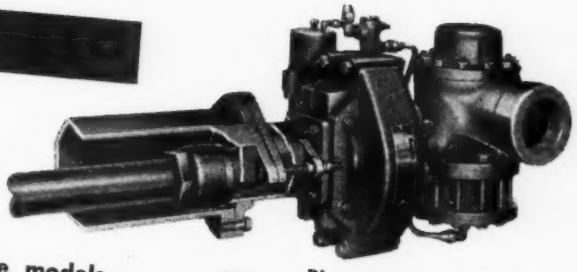
Detroit 31, Michigan

DIAMOND SPECIALTY LTD. • Windsor, Ontario

Air Operated

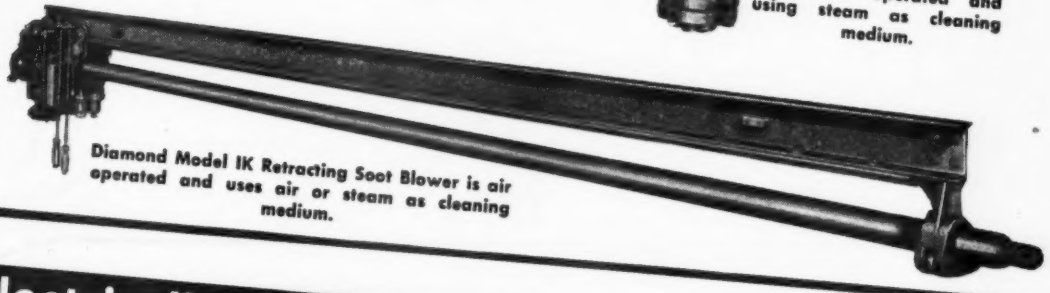
Models of Diamond Soot Blowers that use steam for the cleaning medium as well as those using air for cleaning are operated by air. There are models other than those illustrated that can be air operated . . . for example the Model IF shown below electrically operated.

The operation and control of the various blowers used in Diamond Automatic Sequential Soot Blower Systems are sufficiently flexible to meet the requirements and preferences of the individual steam plant.



Diamond "Air Puff" Soot Blower is air operated and uses air as cleaning medium.

Diamond Model G9B Soot Blower air operated and using steam as cleaning medium.



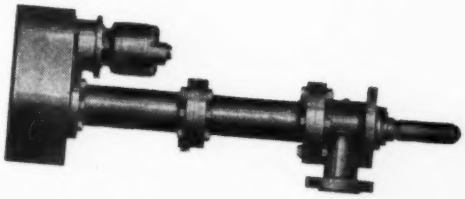
Diamond Model IK Retracting Soot Blower is air operated and uses air or steam as cleaning medium.

Electrically Operated

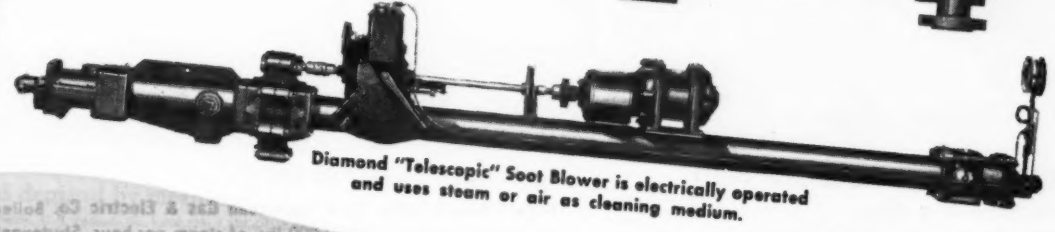
Illustrated here are representative models of Diamond Soot Blowers that are electrically operated; both air and steam are used as the cleaning medium. There are other models that can be operated electrically when preferred.

Diamond Automatic Sequential Soot Blower Systems have sufficient variety to permit the selection of those models that are particularly suited to the conditions encountered in the individual steam plant.

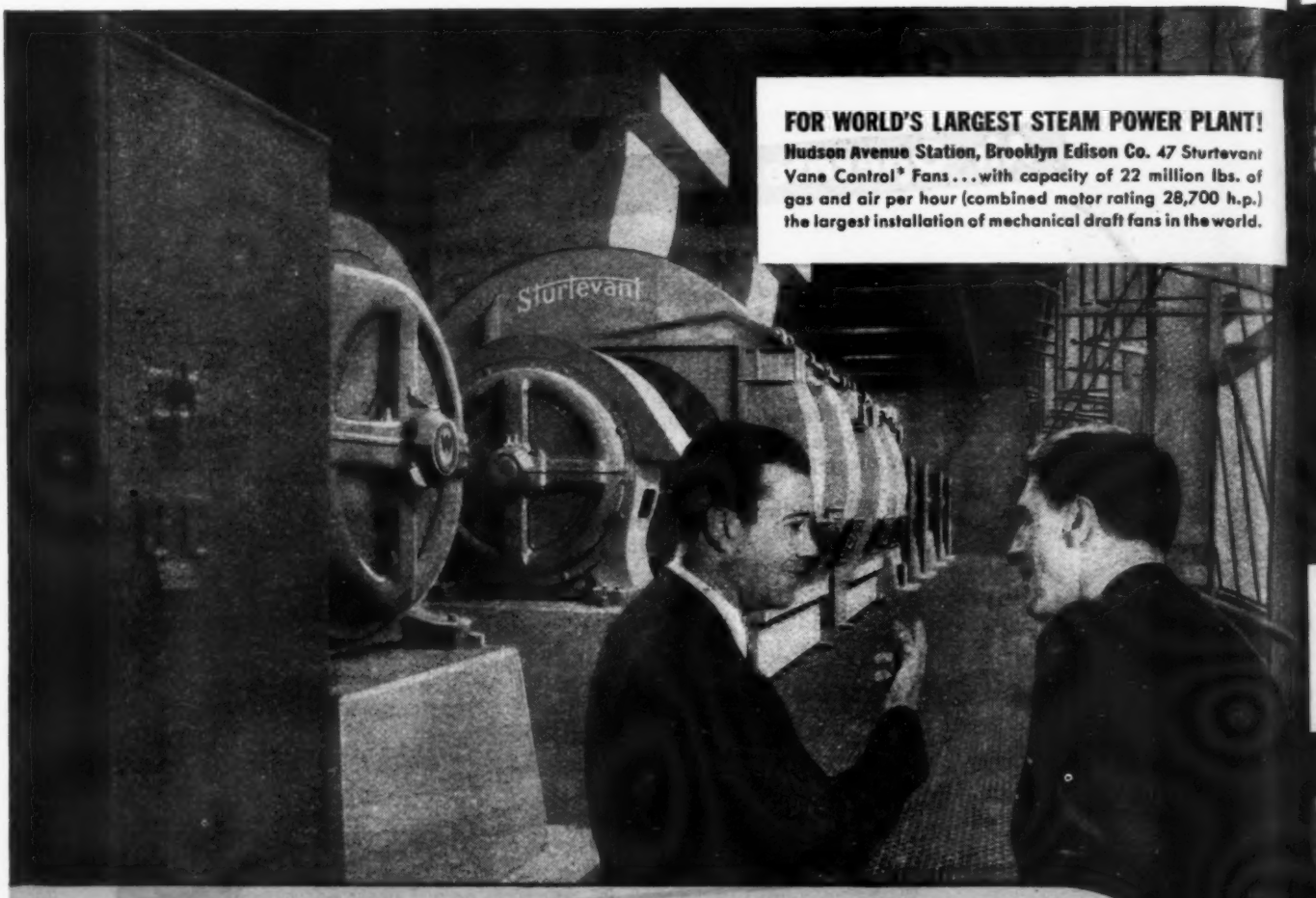
Diamond Model G9B Soot Blower electrically operated and using steam as cleaning medium.



Diamond Model IF Retracting Soot Blower electrically operated and using air as cleaning medium.



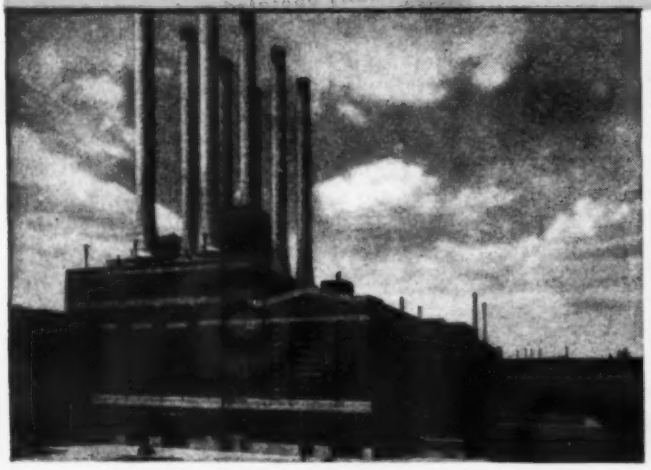
Diamond "Telescopic" Soot Blower is electrically operated and uses steam or air as cleaning medium.



FOR WORLD'S LARGEST STEAM POWER PLANT!

Hudson Avenue Station, Brooklyn Edison Co. 47 Sturtevant Vane Control® Fans . . . with capacity of 22 million lbs. of gas and air per hour (combined motor rating 28,700 h.p.) the largest installation of mechanical draft fans in the world.

Draft fan experience like this assures RELIABILITY

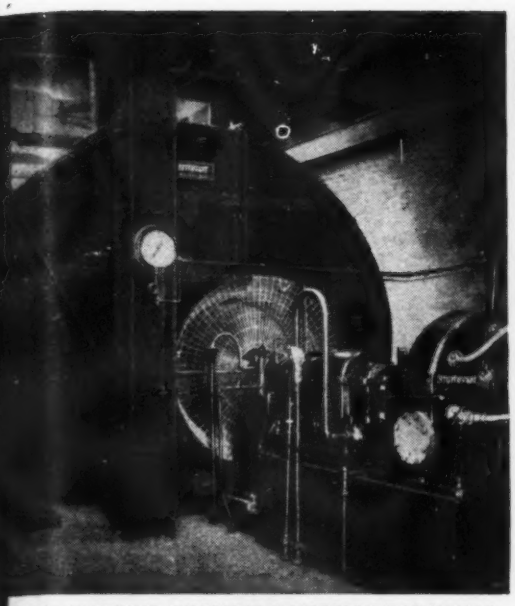


FOR WORLD'S LARGEST INDUSTRIAL UNIT!

River Rouge Plant, Ford Motor Co. 6 Sturtevant Vane Control® Draft Fans furnish draft for this boiler—rated 900,000 lbs. of steam per hour at 1400 lbs. pressure and 900°F.—the world's largest super-pressure industrial unit.

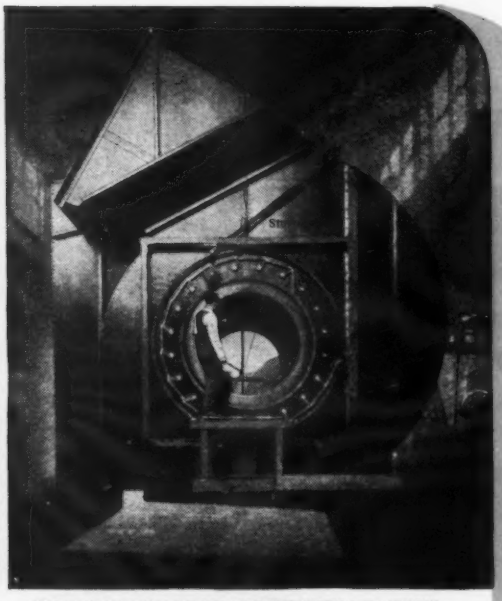
FOR WORLD'S LARGEST BOILER!

Logan, West Virginia Plant, American Gas & Electric Co. Boiler has rated capacity of 1,000,000 lbs. of steam per hour. Sturtevant Vane Control® Forced and turbine-driven Induced Draft Fans chosen for this boiler, the induced fans operating at a tip speed of over 4 miles per minute! Fans shown prior to shipment.



FOR WORLD'S CHAMPION STEAM PRODUCER!

East River Station, New York Edison Co. 33 Sturtevant Draft Fans driven by Sturtevant Steam Turbines. Each of last 3 boilers, rated at 800,000 lbs. per hour, reached a peak of 1,250,000 lbs. with Sturtevant Fans.

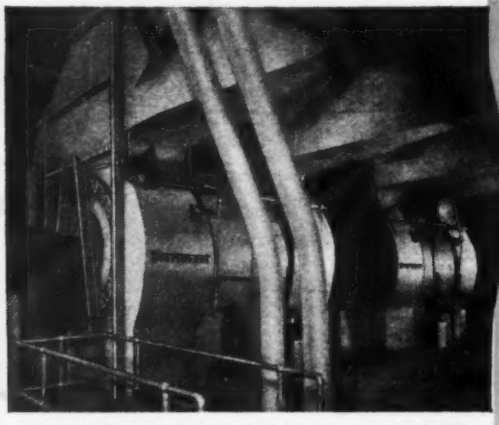


WORLD'S LARGEST HIGH DUTY I.D. FAN!

Burlington Station, Public Service Electric & Gas Co., N. J. Capacity of this Fan is 335,000 c. f. m. at 13" static pressure! Fan wheel almost 9 feet in dia.—tip speed 19,000 feet per minute—weight of fan and bases, 40 tons!

WORLD'S LARGEST TURBO-GENERATOR UNIT!

State Line Station, Chicago District Electric Generating Corp. 24 Sturtevant Vane Control* Fans installed in plant using the largest turbo-generating unit ever built... 208,000 kilowatts capacity.



WORLD'S LARGEST High Pressure BOILER!

Twin Branch Station, Indiana & Michigan Electric Co. Rated 2400. lbs. pressure served by Sturtevant Induced Draft and Fly Ash Collector Systems—170,000 c. f. m. and 18" static pressure—and Sturtevant Forced Draft Fans.

AIR CONDITIONING

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HEATING

VENTILATING

MECHANICAL DRAFT

DUST AND FUME CONTROL

It's ready to go to bat for you—Sturtevant mechanical draft experience that has satisfied the needs of power engineers not only on these world's largest installations, but in a large majority of U. S power plants.

You get years of experience in research . . . in design of mechanical draft fans . . . use of alloy steels and heat treating—all factors of first-hand importance in constructing modern high duty fans. It's this knowledge that enables Sturtevant to deliver high efficiency fans . . . able to withstand high speeds, high temperature, high pressures and large volumes . . . capable, too of instant response to varying load demand by means of Sturtevant Vane Control*.

*Reg Trade Name, U.S. Patents No. 1,460,428; 1,578,848; 1,846,863; 1,989,413

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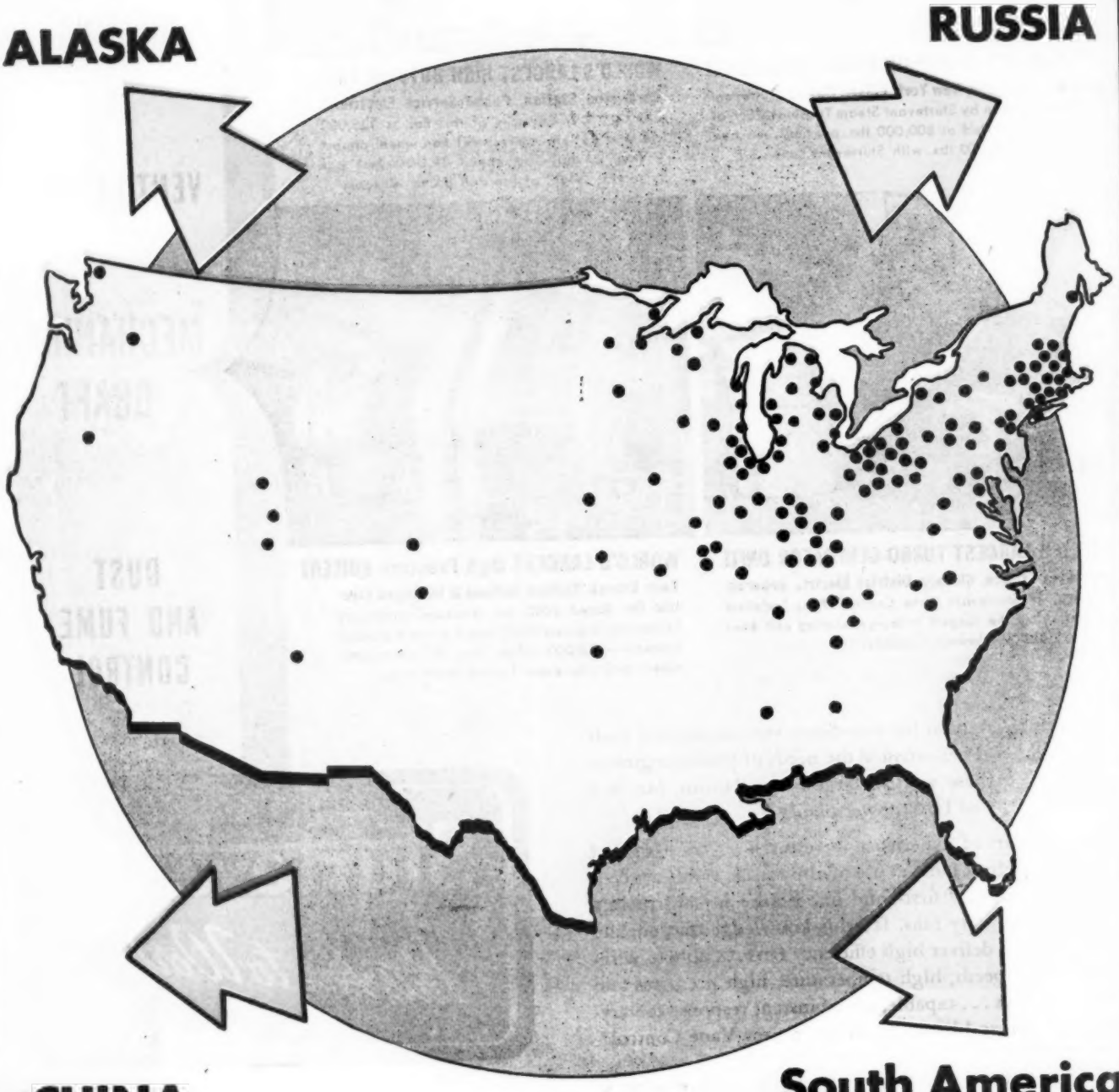
REG. U. S. PAT. OFF.
Puts Air to Work

SPREADING ALL

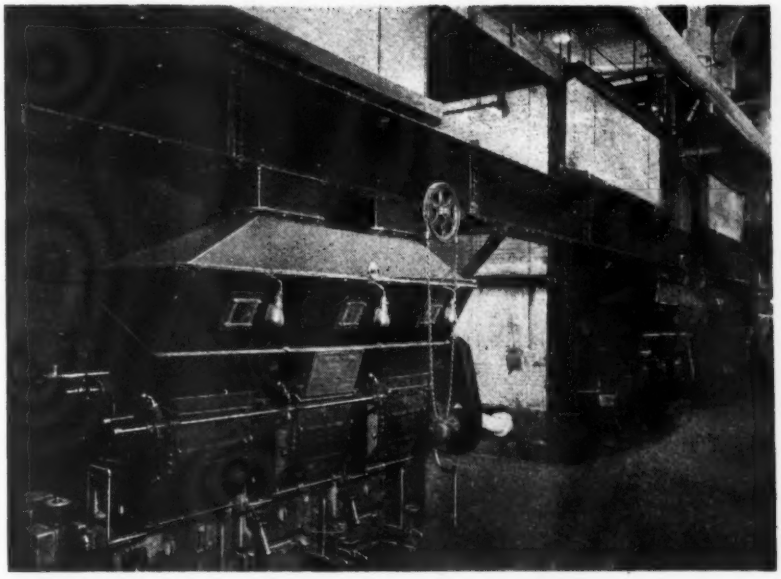


OVER THE MAP

because

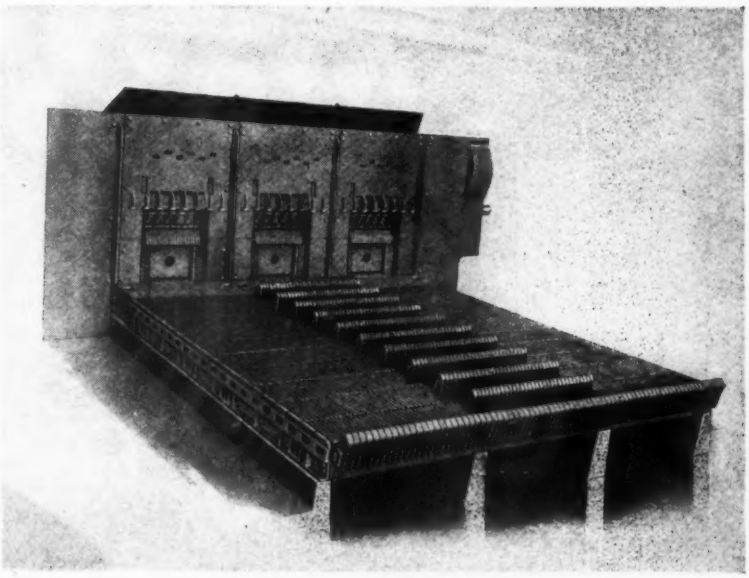
C-E SPREADER STOKERS BURN NOT ONLY CHEAPER COAL BUT A WIDER VARIETY OF COALS

They Are Spreading Economy, Spreading Convenience, Spreading in Use



Installation of three C-E Spreader Stokers firing three C-E Steam Generators, Type VU.

Rear view of C-E Spreader Stoker with one section of the grates in dumping position.



Even when peace comes, poor coal is something industry will have to live with for some time. Yet, for a rapidly growing number of industrial plants, poor coal will not be a serious handicap in steam generation. For, thanks to the installation of C-E Spreader Stokers, these foresighted plants are now able to utilize almost any grade or type of coal available.

It is one of the virtues of the C-E Spreader Stoker that it will burn satisfactorily not only the cheaper coals but a greater variety of coals both good and bad. Because of this all-round versatility, plus convenience and economy, the use of these advanced design stokers is spreading all over the world.

C-E Spreader Stokers have been applied to boilers of all types with capacities ranging from about 5,000 to 175,000 lb of steam per hr. They are used in a wide variety of fields — chemical, metallurgical, refining, food, rubber, distilling, brewing, railway, marine, utilities, schools, hospitals, laundries, light and heavy manufacturing.

If C-E Spreader Stokers are suitable for your plant — and they probably are — you can face the handicap of poor coal with assurance by planning now for an early installation. A-863

COMBUSTION ENGINEERING

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E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

BAILEY BOILER METERS ENGINEERED

Bailey Field Engineers backed installations adjust each Bailey Boiler

The use of Bailey Boiler Meters and Bailey engineering service for fuel conservation dates back through World War I.

Modern installations of Bailey Boiler Meters usually include Bailey Boiler Control to automatically maintain maximum fuel economy and other desirable operating conditions.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHE

—YOUR PASSPORT to FUEL CONSERVATION

by the know-how gained from thousands of successful Steam Flow—Air Flow Meter to the particular requirements of the unit which it serves. The meter then serves as a guide to firemen in obtaining maximum fuel conservation in everyday operation.

Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Much of this engineering work is done in the user's plant by Bailey Field Engineers who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has "know-how" at his command which was developed by over 25 years experience with the Steam Flow—Air Flow method of combustion control. This includes the records of tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that this engineer has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation and other benefits which result from the intelligent use of correctly selected and properly applied instrumentation. G-21

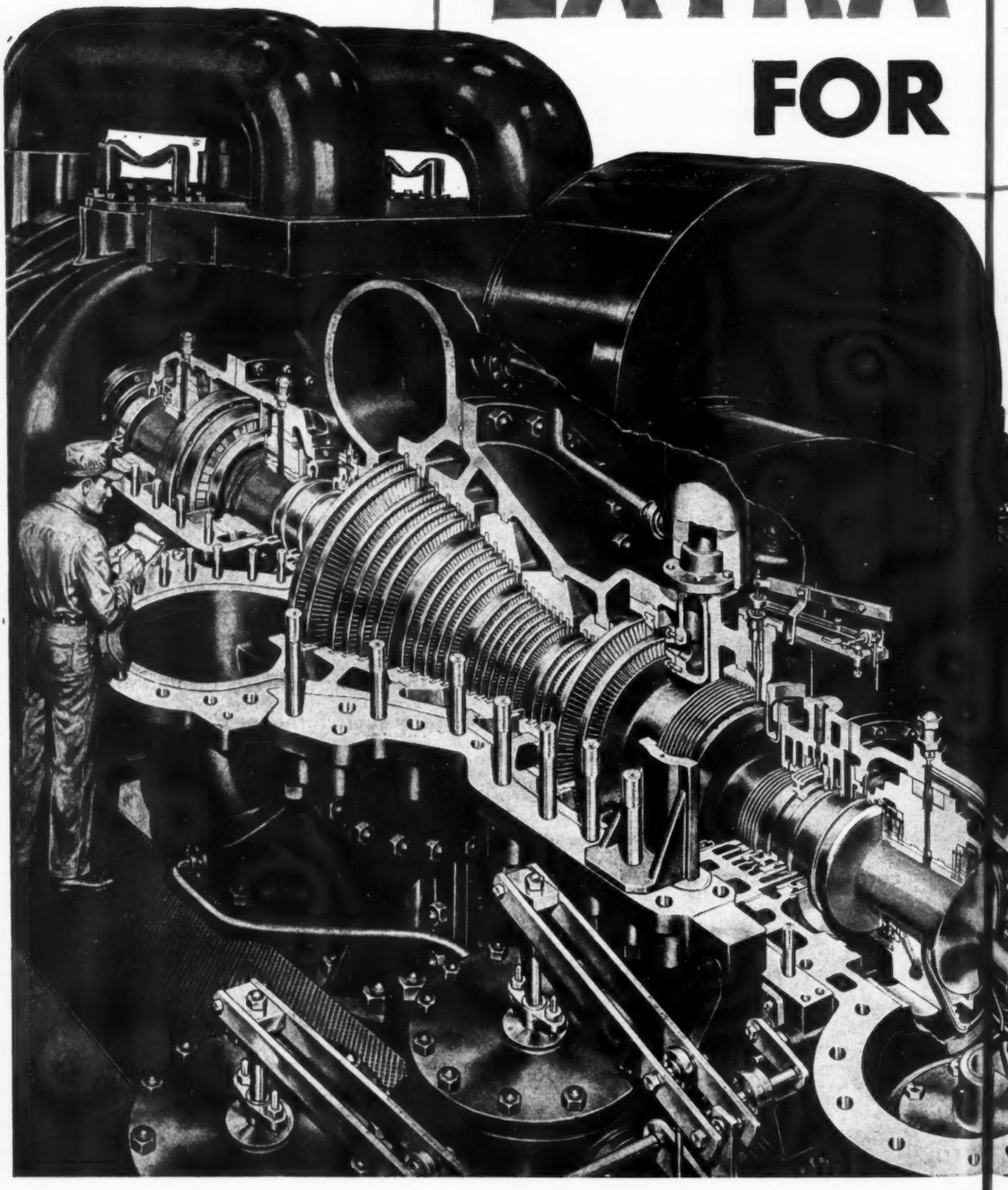
BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

he Complete Combustion Control System

NTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

EXTRA

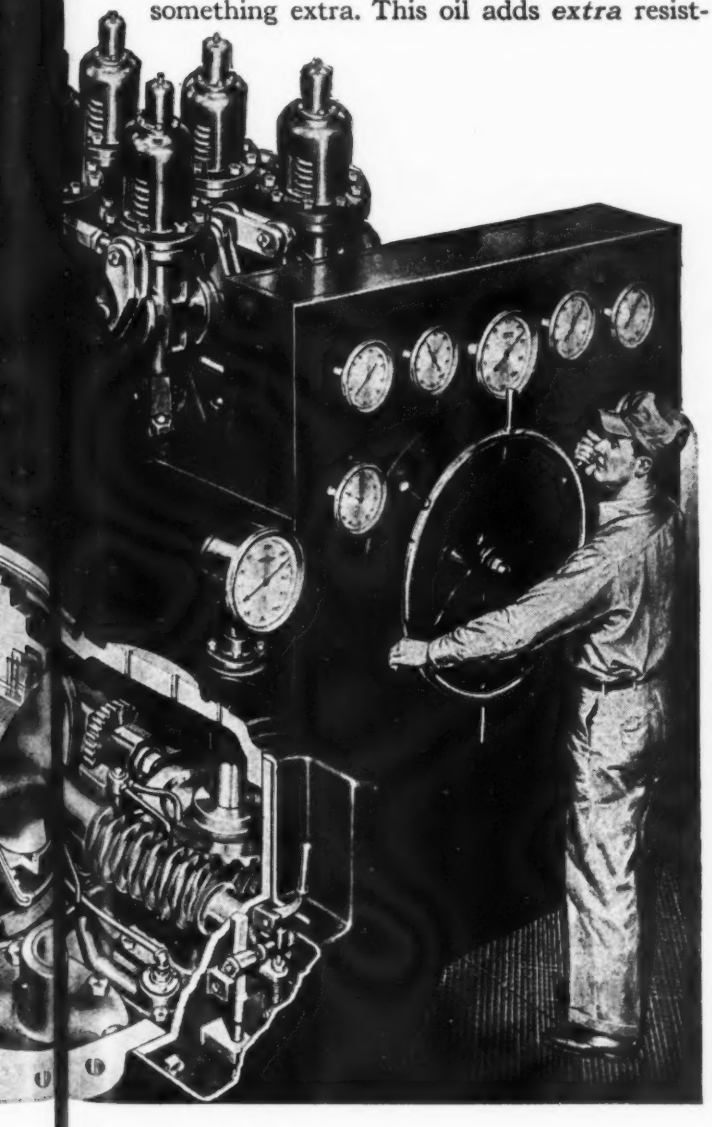
FOR



PROTECTION
YOUR TURBINE!

THIS unique cutaway drawing of a giant 200,000 h.p. turbine shows far better than words why you need *something extra* in your turbine oil.

Socony-Vacuum's great new turbine oil—Gargoyle D.T.E. Oil 797—gives you this something extra. This oil adds *extra* resistance to oxidation, deposits and rust, to a base stock that is in itself an excellent turbine oil.



In severe tests, Gargoyle D.T.E. Oil 797 has stood up far longer than any other turbine oil. Now, it's in service in turbines ranging in size from 1500 KW, to more than 50,000 KW.

Get full performance facts and figures on Gargoyle D.T.E. Oil 797, from your Socony-Vacuum Representative. Then, give your turbine this *extra protection* against oxidation and rust for *extra performance*.

Socony-Vacuum's FIVE STEPS to Lower Production Costs for You!

1. Lubrication study of your entire plant.
2. Lubrication schedules and controls.
3. Lubricant storage and handling system.
4. Skilled engineering counsel.
5. Progress reports of benefits secured.

Call in
SOCONY-VACUUM
GARGOYLE Lubricants
for Correct Lubrication

SOCONY-VACUUM OIL COMPANY, INC.,
Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California.

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No. 1 HELPFUL HINTS ON APPLYING CAPACITORS

To help you improve power factor, reduce kva demand, increase circuit loadability and, often, reduce power costs

A WORKABLE DEFINITION OF THE TERM "POWER FACTOR"

The term arose because, in alternating-current circuits, the energy supplied to induction motors, transformers, and other inductive equipment is composed of *two* kinds of current:

1. Power-producing (or "working") current, which is converted by the equipment into useful work.
2. Reactive current (also called "magnetizing," "nonworking," or "wattless"), which is needed to magnetize inductive equipment before it will operate and while it is operating.

This current is *not* converted by the equipment into useful work. For example, it provides the flux across the air gap of an induction motor, through which the kilowatts flow to do work connected to the shaft. The *vector sum* (explained at the right) of these two currents is termed the "total current"—the actual current supplied to the load.

"Power factor" simply expresses the ratio of power, or "working," current to the total current.

The "working" current is usually expressed in watts or kilowatts, the total current in volt-amperes (volts × amperes) or kilovolt-amperes $\frac{(\text{volts} \times \text{amperes})}{1000}$, or in a 3-phase system $\frac{(\sqrt{3} \times \text{volts} \times \text{amp})}{1000}$.

Hence, in a formula: Power factor $= \frac{\text{kw}}{\text{kva}}$

Example:

What is the power factor of the load on a 460-volt, 3-phase system if an ammeter shows 100 amperes in the circuit and a wattmeter reads: 63.6 kilowatts?

Since, in a 3-phase circuit:

$$\text{Kva} = \frac{\sqrt{3} \times \text{volts} \times \text{amperes}}{1000}$$

$$= \frac{1.73 \times 460 \times 100}{1000} = 79.6$$

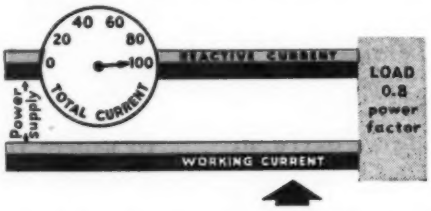
$$\text{Power factor} = \frac{\text{kw}}{\text{kva}} = \frac{63.6}{79.6} = 0.8 \text{ or, as often expressed, } 80\%.$$

WHAT "POWER-FACTOR IMPROVEMENT" REALLY IS

To "improve power factor" you simply neutralize or eliminate the reactive current from the feeder by supplying it locally. When this current is completely neutralized, all the current is "working." When the "working" current and total current are equal, the power factor is "unity," or, as sometimes expressed, 100%.

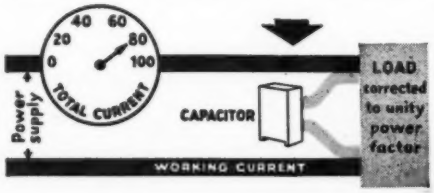
Capacitors are usually the easiest, quickest, and least expensive method of supplying reactive current. They are "generators" of the reactive current required by inductive loads. When they are located near the load, they furnish the magnetizing requirement direct, and the power circuit need furnish only the "working" current.

Using the case at left as an example:



The load draws 100 amperes from the supply circuit. Because part of the current is consumed by the magnetizing requirements (orange line) of the load, only 80 amperes are actually being converted into useful work.

After a capacitor is added, the magnetizing requirement is supplied by the capacitor, and it is necessary for the supply circuit to deliver only 80 amperes to get exactly the same work. *No feeder capacity is wasted in nonproductive work.*

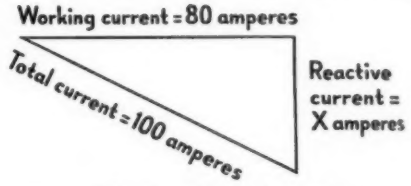


Similarly, if four such loads were fed from the same circuit, the supply current would be sufficiently reduced, by means of the capacitor, to make it possible to add another load of the same magnitude without increasing the current.

WHERE 100 − 80 = 60

In the first sketch shown above, it would appear that since the current supplied to the load is 100 amperes, and since only 80 amperes of this are being converted to useful work, the magnetizing requirement of the load must be the difference between the two, or 20 amperes. Hence, it might further be assumed that a 20-ampere capacitor should be installed to compensate for the magnetizing requirement. However, neither of these assumptions is correct. The subtraction of the "working" current from the total current never equals the magnetizing requirement—an important fact to remember. The relationship of the "working" current to the total current is known as a "vectorial" relationship. Although difficult to explain in a few words why this is so, the relationship itself is easy to show with a right triangle.

This right triangle makes it easy to find the correct value of the magnetizing



current (X), by using the well-known formula for a right triangle, viz., the square of the longest side is equal to the sum of the squares of the other two sides. Therefore,

$$(80)^2 + (X)^2 = 100^2$$
$$(X)^2 = 10{,}000 - 6400 = 3600$$
$$X = 60$$

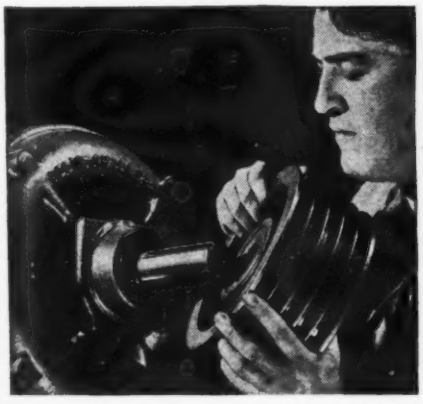
Therefore, a capacitor that will deliver 60 amperes must be installed to supply the full magnetizing requirement of the load, rather than a 20-ampere unit, as might at first be supposed.

Capacitor *application* data can be obtained by writing for Bulletin GEA 3225A. Bulletin GEA-2742C will bring you *product* data on Pyranol capacitors for power-factor improvement. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

This locks this to this in 1 quick operation

Allis-Chalmers' new "Magic-Grip" with tapered split bushing is put on, aligned, locked to shaft *as a unit* — making it the fastest mounting and demounting sheave on the market!



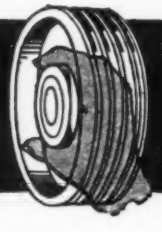
1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.

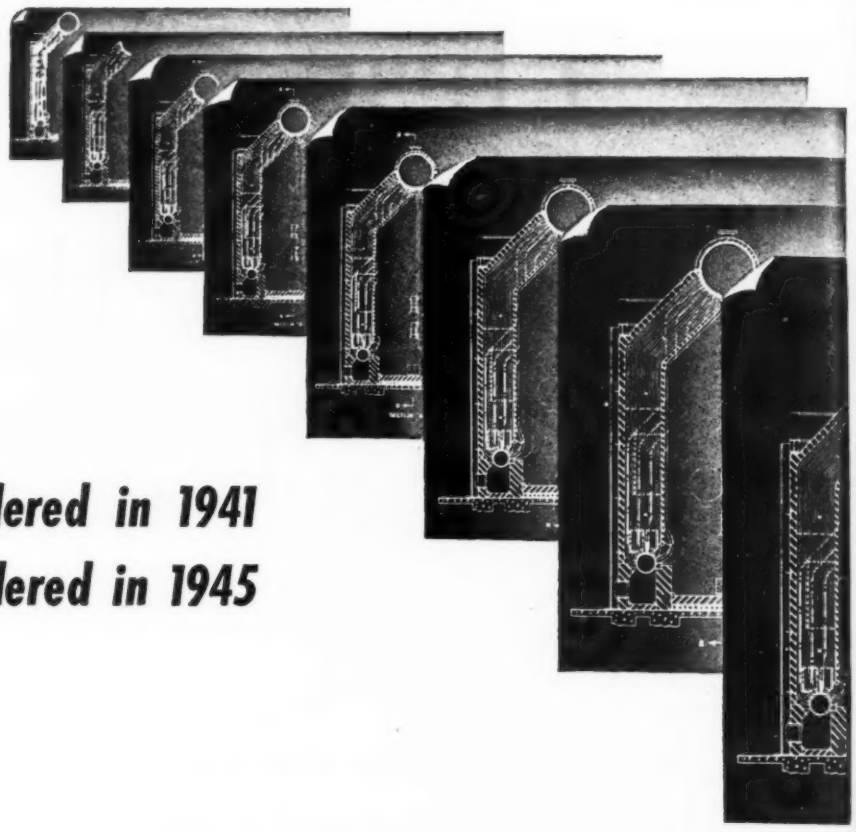
3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1757

Allis-Chalmers Texrope "MAGIC-GRIP" SHEAVES



NINE "S.A." BOILERS FOR ONE



1st Unit Ordered in 1941
9th Unit Ordered in 1945

ACTUAL experience with the first unit proved that this design of boiler demonstrates in operation the advantages that are claimed for it.

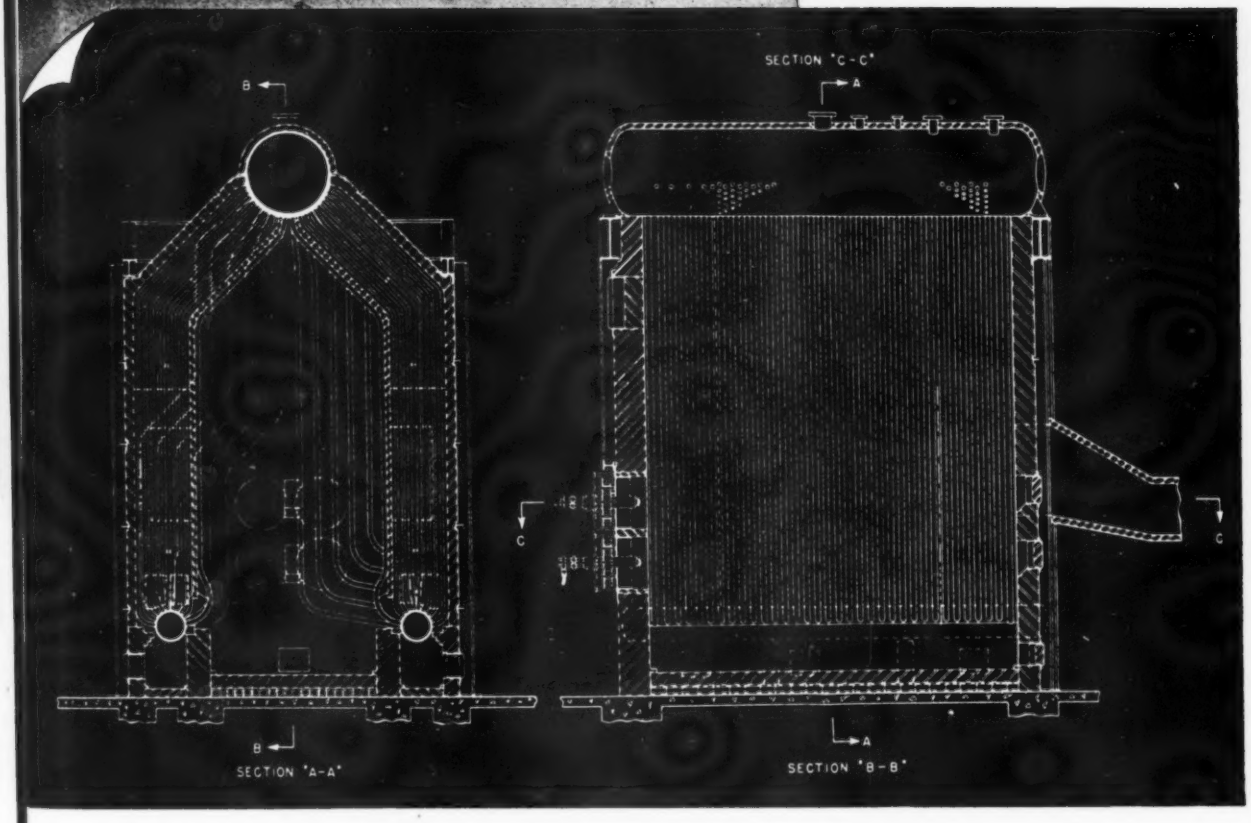
- Low Draft Loss
- Complete Combustion due to Long Flame Travel
- Sufficient Cooling of Gases to Prevent Slagging
- High Average Efficiency
- Wide Range of Superheat Control

Performance tells the story... there was no question as to what boiler to install when increased steam demands made additional steam capacity necessary.

FOSTER WHEELER CORPORATION
165 BROADWAY • NEW YORK 6, N. Y.

FW FOSTER

E OIL REFINERY IN *FIVE* YEARS

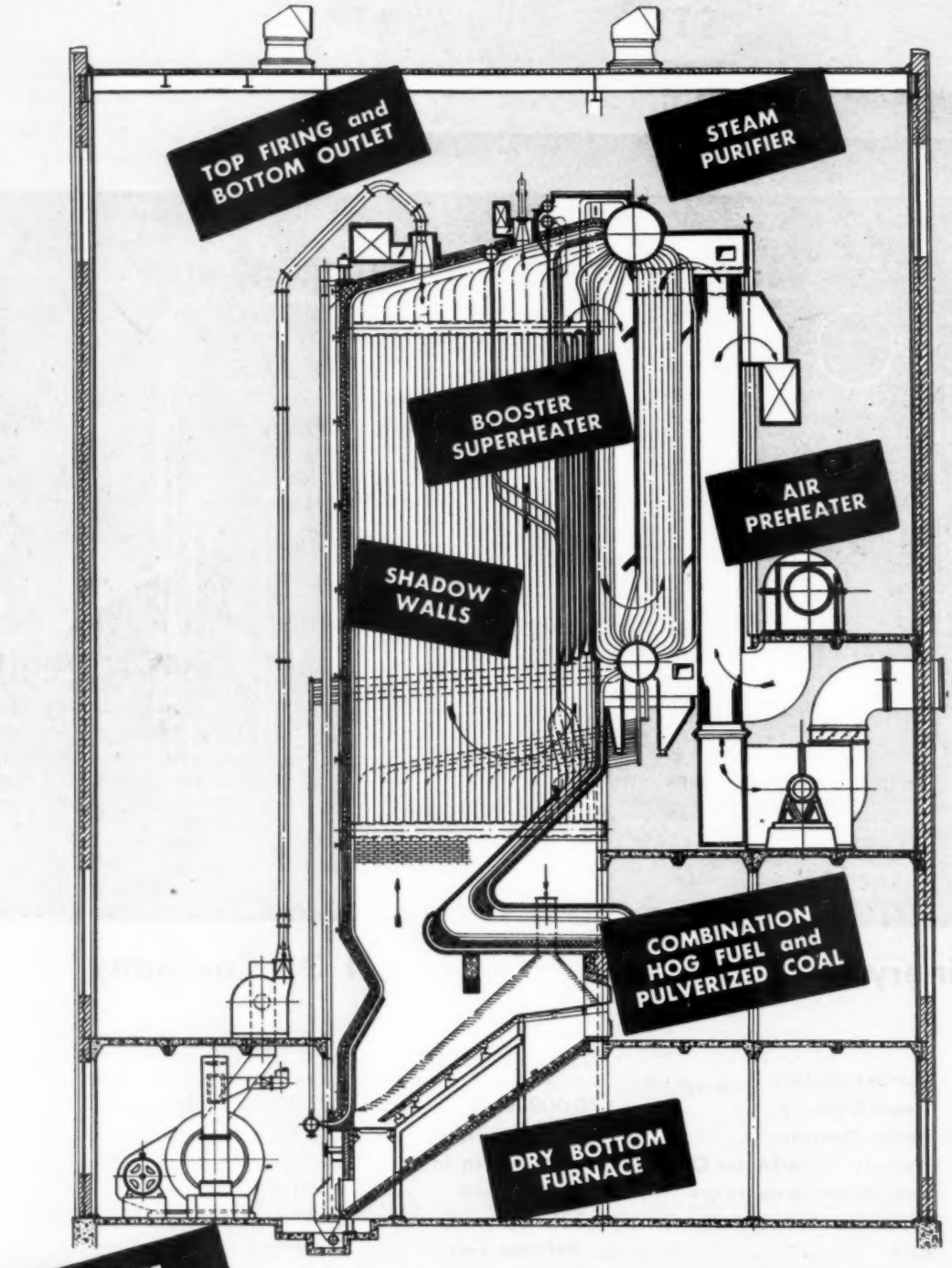


Refinery Installation For a Prominent Oil Company

	Present Operation	*Contemplated Future Operation*
Number of Units	5	9
Steam Capacity	70,000 lb. per hr.	70,000 lb. per hr.
Design Pressure	645 lb. per sq. in.	645 lb. per sq. in.
Pressure: Superheater Outlet	250 lb. per sq. in.	600 lb. per sq. in.
Final Steam Temperature	(Saturated)	750 degrees F.
Feedwater Temperature	225 degrees F.	300 degrees F.
Fuel	Refinery Gas	Refinery Gas
Efficiency	79.1 per cent	83.0 per cent (with air heater)

WHEELER

EXCLUSIVE FEATURES



A PRACTICAL, COMPACT UNIT for a COMBINATION of HOG FUEL and PULVERIZED COAL FIRING

offered by KVS

IN STEAM GENERATOR DESIGN

TO ASSURE PROPER COMBUSTION, GREATER EFFICIENCY and SAVE FUEL

● TOP FIRING AND BOTTOM OUTLET

Better control of combustion is assured by this design, because you don't have to "fight" the coal you want to burn. Radiant heat is evenly distributed over furnace area. With properly prepared coal (assured by the KVS Pulverizer) and bottom outlet, carbon loss is 100% controlled.

● PERFECT PULVERIZATION

With the KVS Integral Drive Tube Mill, perfect pulverization is controlled by air separation. All grades of coal can be properly prepared at low cost for power and maintenance.

● BOOSTER SUPERHEATER

Steam temperature is thermostatically controlled by a direct, separately fired booster superheater, with combustion completed in main furnace.

● SHADOW WALLS

KVS Water Walls provide increased heat absorbing surface, assure a clean furnace and avoid refractory maintenance.

● AIR PREHEATER

In this design the Air Preheater is compactly included in the structure of the boiler itself.

● DRY BOTTOM FURNACE

This feature in KVS design eliminates concentration of heat and thereby minimizes tube failures.

● STEAM PURIFIER

This KVS development provides a highly efficient means of purifying steam. Less than one-half of one part per million of impurities is carried over.

● COMBINATION HOG FUEL AND PULVERIZED COAL

This combination of firing assures economy through ability to burn waste. These two methods of firing are combined in one compact unit, and are arranged to operate without interference one with the other. Each fuel involved burns independently of the other or together, as required by operating conditions.

● KVS ENGINEERING EXPERIENCE CAN BE APPLIED TO SOLVE YOUR PROBLEM

KVS steam generating equipment has been performance-proved over the years. All components together with installation are available under one responsibility from initial design to plant complete and ready for operation by customer. Consult KVS on your requirements.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

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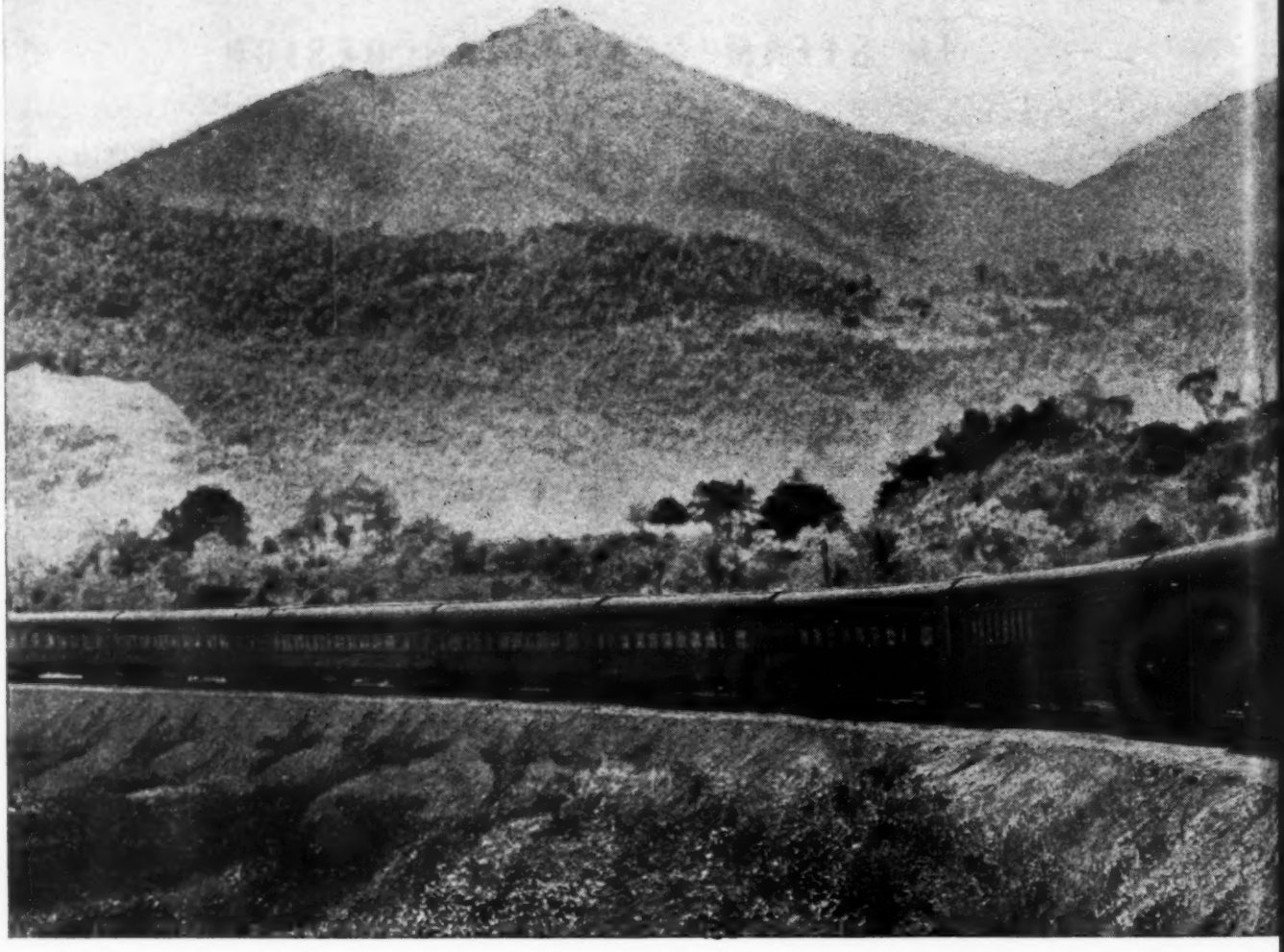
STEAM FOR



SPECTACULAR symbol of steam power, the Norfolk and Western system's new streamlined locomotives develop 6000 hp., and attain speeds in excess of 100 mph. Total weight of the engine and tender is 867,600 lbs.

In every type of steam generating plant—stationary as well as mobile—dependable, full-power output is possible only when lubrication is thoroughly effective. To assure this, more and more operators are using Texaco.

Whatever the steam temperature or pressure, in engines old or new, there is a Texaco steam cylinder oil that will atomize completely, adhere to cylinder walls, separate rapidly from exhaust, assure quiet operation and low oil consumption. Because of the benefits Texaco delivers—

More locomotives and railroad cars in the United States are lubricated with Texaco than with any other brand.

In addition, Texaco lubricants have proved so effective in service they are definitely preferred in many other fields. A few of these are listed on opposite page.

Texaco Lubrication Engineering Service is available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—C

THEY PREFER TEXACO

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

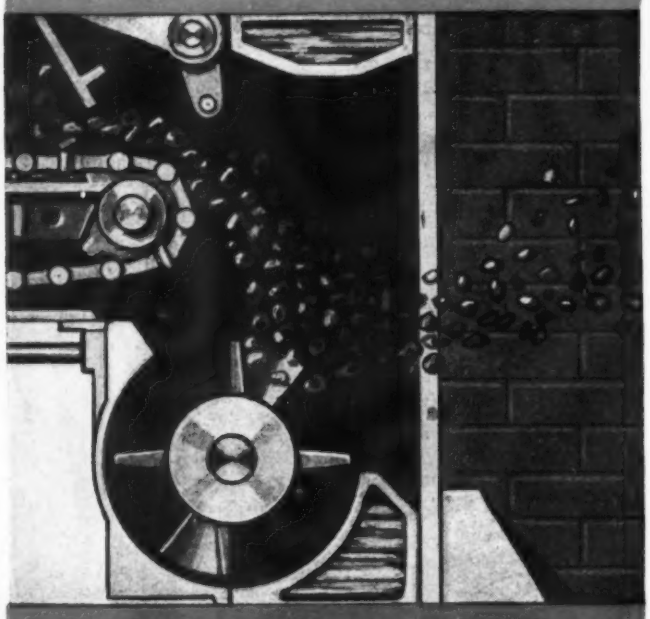
★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

TEXACO

TEXACO

Steam Cylinder Oils

FOR EVERY
STEAM CONDITION



MORE STEAM at LOWER COST

LOOKING FOR a way to trim your fuel costs and boiler room operating expenses? Then you'll surely be interested in every feature of the Æ Perfect Spread Stoker—from its "streamlining with a purpose" to its "crossfiring" principle of combustion.

This modern, dependable stoker efficiently burns any kind or grade of solid fuel, wet or dry, including by-products and plant refuse. Maximum heat from every pound of fuel means more steam at very worthwhile savings. In operation, the stoker is extremely clean and quiet, answering steam demands instantly. It puts an end to many wasteful boiler room practices.

You may find in these and other important advantages the way to cut *your* fuel bills and boost operating efficiency. Write today for the new Æ Perfect Spread Stoker bulletin.

Overthrow ROTOR
SPREADS PERFECT FUEL BED

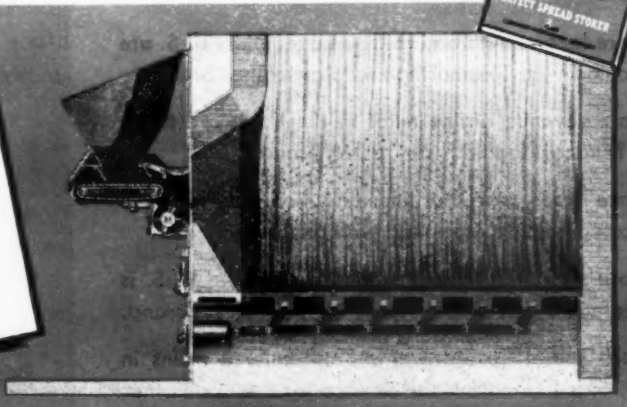
Over-the-rotor feed covers the entire grate area with a "Perfect" fuel bed and causes less wear on the rotor and housing. The uniquely designed and balanced Æ rotor spreads fuel perfectly, the fines burning in suspension and the heavier particles dropping to the grate for thorough combustion. This rotor is an exclusive feature not found in any other stoker.

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2400 Aramingo Ave., Philadelphia 25, Pa.

Æ PERFECT SPREAD STOKER



Other Æ Products: Æ-Taylor Stokers, La-Bel Boilers, Marine Deck Auxiliaries, Rate-Stem Field Power, Diamond Face Grinders

AMERICAN ENGINEERING COMPANY

Subsidiaries: COCHRANE CORPORATION, FARADAY ELECTRIC CORPORATION

PHILADELPHIA 25, PENNSYLVANIA

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A SURE WAY TO BE SURE YOU'RE RIGHT

HOW MANY types and makes of stokers should you consider when specifying new power plant equipment? Two? Four? Eight? To be absolutely *sure* you're right, you'll no doubt want *all* the information you can possibly get on *all* the latest stokers.

That's why we believe you will want to know about the *improved* Taylor Stoker. It is not an untried, untested stoker, but one with a solid 39-year background of highly efficient service all over the world. Now, sweeping improvements have been made that rank it as a stand-out stoker for dependable, low cost steam generation . . . based on *today's* requirements . . . and built to *tomorrow's* needs.

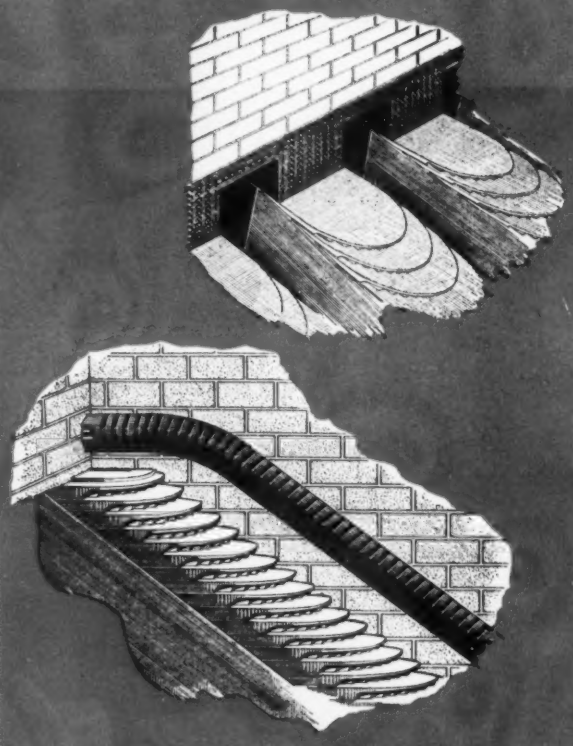
You'll get a great deal of valuable information from the new Type "R" Taylor Stoker booklet, which details every improved feature and its advantages to *you*. Write for it *today*.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

Write us. 2400 Aramingo Ave., Philadelphia 25, Pa.

ANOTHER IMPROVEMENT IN THE TYPE "R" TAYLOR STOKER



AIR COOLING REDUCES SLAG FORMATION

Front Wall Air Boxes, Side Wall Air Nozzles and Half Tuyeres of the Taylor Stoker discharge continuous, uniform air screens that reduce slag and clinker formation on furnace walls. This increases operating efficiency and economy.

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AIR-COOLED & WATER-COOLED

Other Æ Products: Æ-Parfect Spreud Stokers, Le-Hed Bricks, Marine Deck Auxiliaries, Rate-Shaw Fluid Power, Diamond Face Grinders

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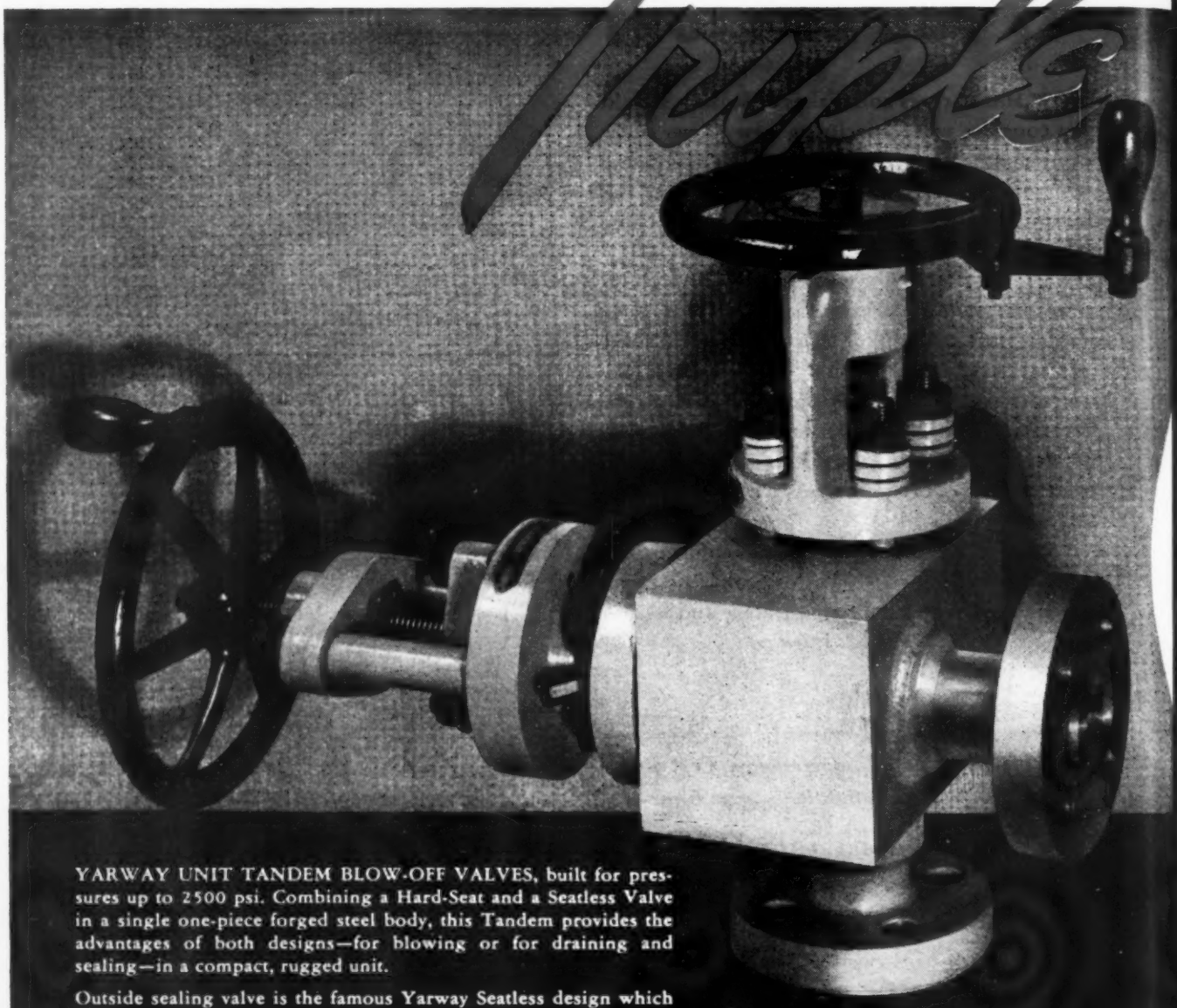
HIGH PRESSURE BOILERS

Triple



YARWAY UNIT TANDEM BLOW-OFF VALVES, built for pressures up to 2500 psi. Combining a Hard-Seat and a Seatless Valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit.

Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special alloys and unique construction features to reduce normal wear in this type of valve. Ask for Catalog B-432.

YARWAY STEAM PLANT EQUIPMENT

NEED THIS...

Protection

Modern Steam Generating Units represent big investments. They are worthy of the best auxiliary equipment available.

Power engineers have found it sound judgment to insist on Yarway Tandem Blow-Off Valves, Yarway Water Columns and Gages, and Yarway Remote Liquid Level Indicators . . . have learned through experience that these are the best protection for their major investment.

Sound design and careful attention to every mechanical and metallurgical detail are the reasons for Yarway performance and leadership. Nearly 40 years' experience with power plant problems—and constant research and development to keep abreast of Industry's requirements—justifies the slogan "Yarway-Equipped—A Mark of Good Engineering."

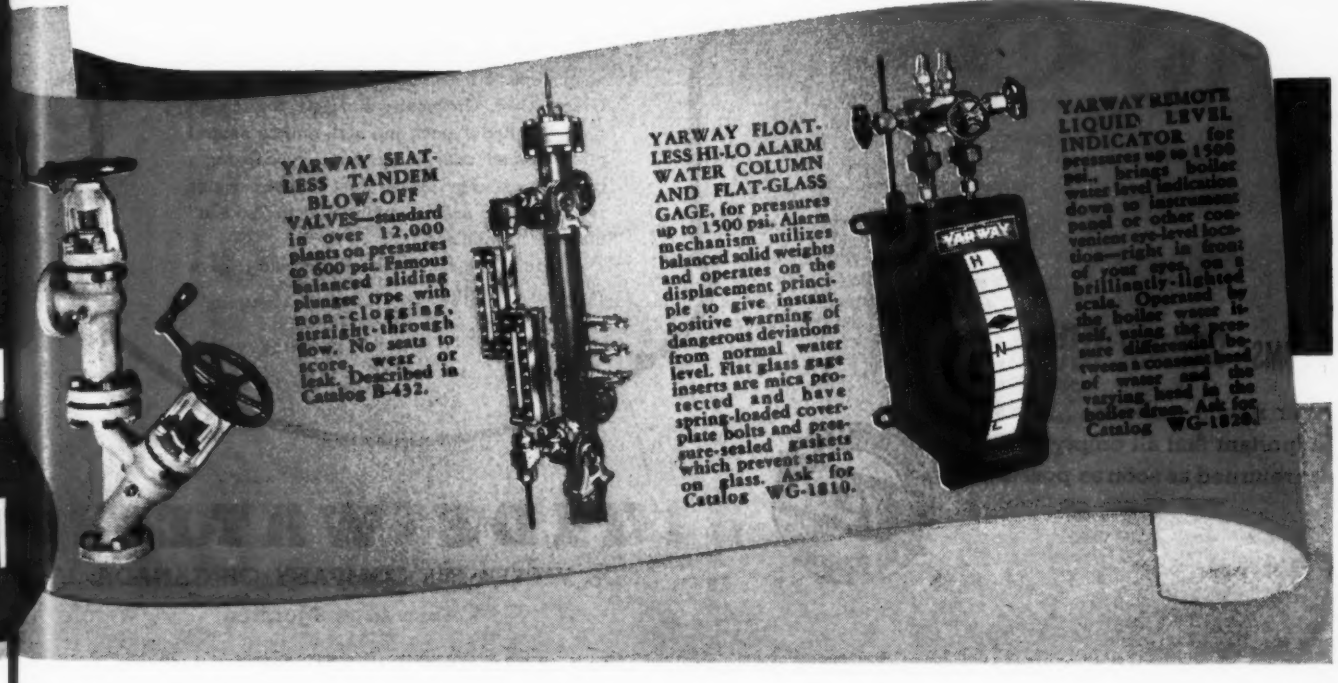
When adding new power equipment, or modernizing your present installation, remember to specify Yarway auxiliaries. Write for descriptive catalogs now.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

●

Blow-Off Valves, Water Columns and Gages, Liquid Level Indicators, Expansion Joints, Impulse Steam Traps, Strainers, Spray Nozzles.

Ask about the new Yarway 30-minute color and sound motion picture, available for group showings.


YARWAY SEATLESS TANDEM BLOW-OFF VALVES—standard in over 12,000 plants on pressures to 600 psi. Famous balanced sliding plunger type with non-clogging, straight-through flow. No seats to score, wear or leak. Described in Catalog B-432.
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND FLAT-GLASS GAGE, for pressures up to 1500 psi. Alarm mechanism utilizes balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous deviations from normal water level. Flat glass gage inserts are mica protected and have spring-loaded cover-plate bolts and pressure-sealed gaskets which prevent strain on glass. Ask for Catalog WG-1810.
YARWAY
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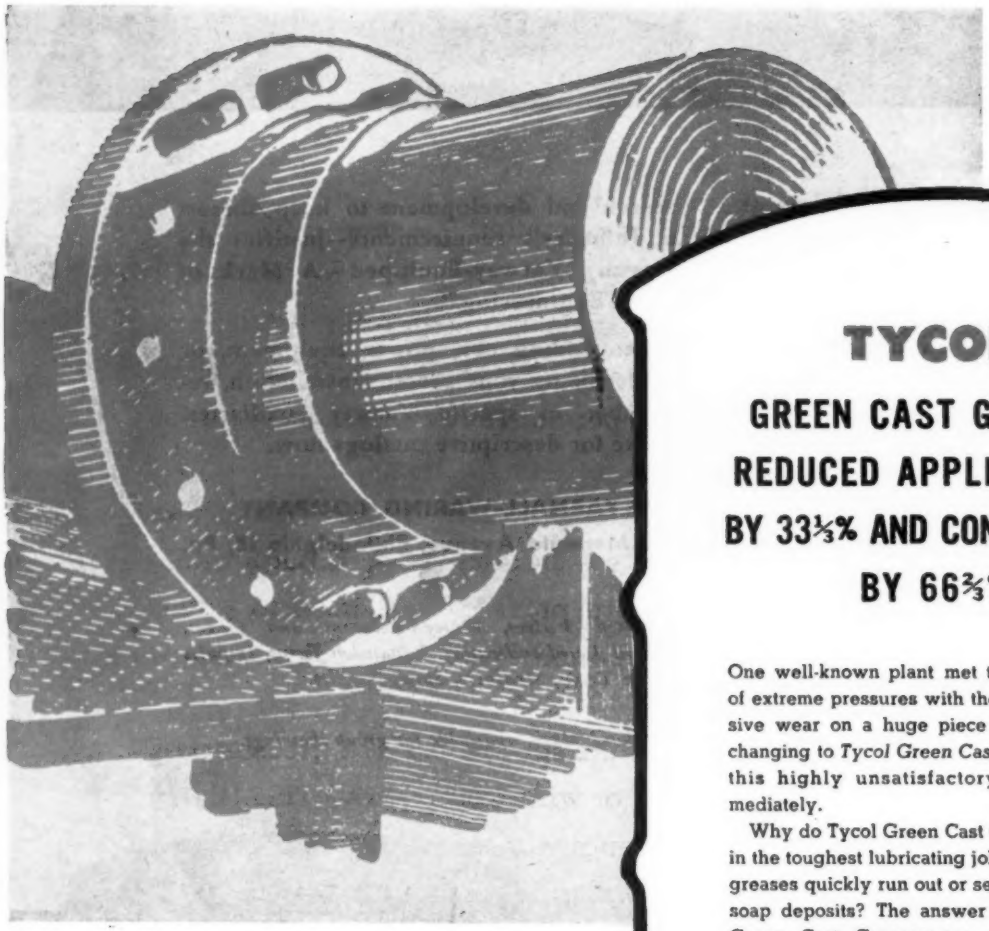
YARWAY REMOTE LIQUID LEVEL INDICATOR for pressures up to 1500 psi., brings boiler water level indication down to instrument panel or other convenient eye-level location—right in front of your eyes, on a brilliantly-lighted scale. Operated by the boiler water itself, using the pressure differential between a constant head of water and the varying head in the boiler drum. Ask for Catalog WG-1820.

"Engineered Lubrication"...



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GREEN CAST GREASES REDUCED APPLICATIONS BY 33⅓% AND CONSUMPTION BY 66⅔%

One well-known plant met the usual trouble of extreme pressures with the resultant excessive wear on a huge piece of equipment — changing to *Tycol Green Cast Grease* stopped this highly unsatisfactory condition immediately.

Why do Tycol Green Cast Greases stand up in the toughest lubricating jobs — where other greases quickly run out or separate into caked soap deposits? The answer is simple. Tycol Green Cast Greases are made from high quality cylinder stock and well refined neutral oil combined with a minimum of soap for a given consistency. Green Cast Grease is water repellent . . . and is engineered to "take it" under all conditions.

A Tide Water Engineer will be glad to give you full information.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned as soon as possible.

INDUSTRIAL TYCOL OILS-GREASES

TIDE WATER

TIDE WATER OIL COMPANY OF CANADA, LTD.

Toronto • Montreal

...the TYCOL way

CUTS DOWN REPAIRS...
SPEEDS UP PRODUCTION

If you want peak efficiency . . . low-cost operation — turn to Tycol "Engineered Lubrication" for all-important help in securing these results. Why? Because each Tycol lubricant is scientifically engineered to meet definite service conditions . . . to reduce wear and maintenance costs to a minimum. That's why so many successful operators have turned to Tycol for low-cost lubrication.

In developing this individualized line of lubricants, Tide Water has complete control over its own products — from oil field, through transportation, to refining. The most modern processes are used to refine selected crudes . . . to blend and compound Tycol's "specifically engineered" oils and greases.

For complete information regarding the specific oils and greases best suited to meet your requirements, call or write your nearest Tide Water Associated office. There a Tide Water engineer, thoroughly experienced in all phases of industrial lubrication, will give you the full benefit of his knowledge.

Have you received your copy of "Lubricania"?

This informative handbook, "Tide Water Associated Lubricania", gives clear, concise descriptions of the basic tests used to determine important lubrication properties — Pour Points, Viscosity, Neutralization, and many others. For your FREE copy write: Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

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then he said to himself

"Failure is just a symptom"

David Lloyd George, the man who *turned the tide* of World War I, gave to postwar planners the secret behind that turn.

In his "War Memoirs" he wrote that when the war was handed to him at the end of 1916 the fortunes of the Allies were at their lowest ebb.

That is history . . . but what he found to be *the cause* and *the cure* is as fresh as though written to guide the strategy of today's business planners. Says he:

> "Two failures on key questions had completely transformed the military position to our disadvantage. The first was the failure to realize that this was a war of machinery . . . and we had neglected to *improve* the Allied equipment."

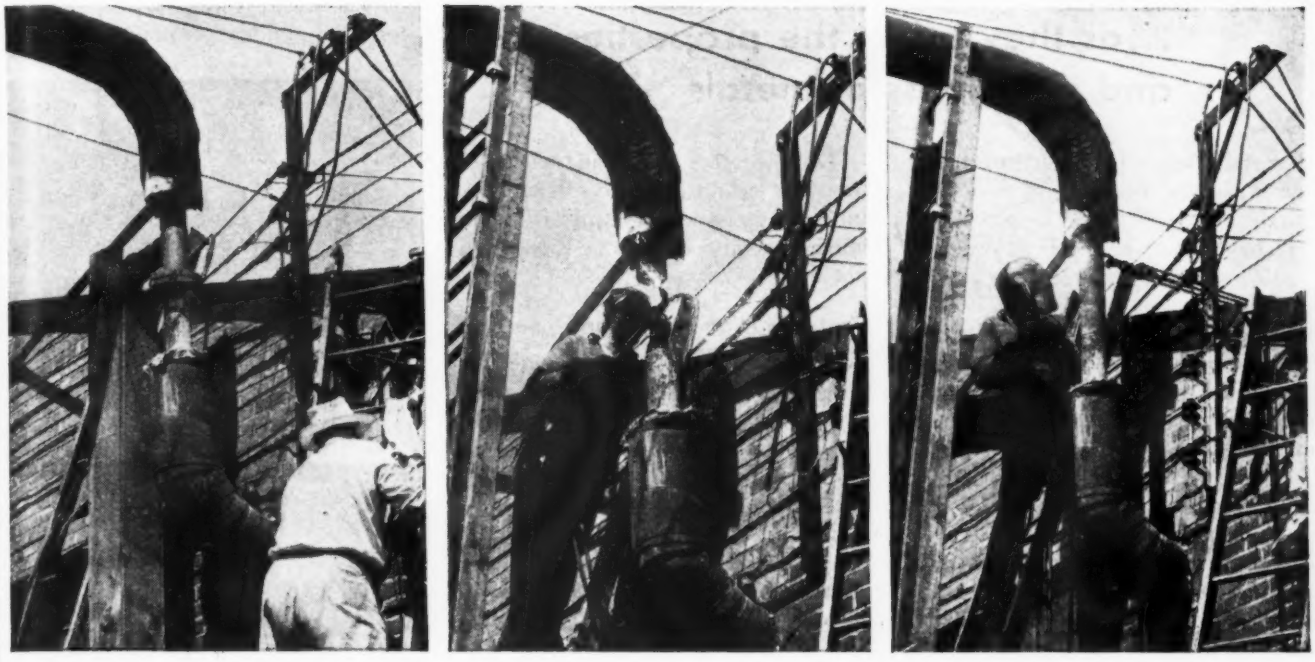
This proves he was a good business man to make that discovery . . . and a better man to ACT before it was too late.

Neglecting to improve equipment, and production, and cost is the surest road to the valley of any business curve.

. . . But for climbing out, and up . . .

"IMPROVEMENT...the key," *he said*

LOOK, how recourse to arc welding improves the installation of piping:



Original connection . . . Cutting out old parts . . . Welded, streamlined, leakproof.

Faster...Lower Cost...Maintenance Free

Arc Welding cuts piping installation time up to 50%, reduces costs 20% or more, makes the joints stronger than the pipe itself and permanently leakproof, simplifies painting or insulation, improves appearance and makes alterations easy. The last point, for example: In the steam line alteration shown, a temporary branch was removed and a coupled connection was eliminated. Old parts were cut out with torch. New 15" section of 4" pipe was welded in place with "Fleetweld 5" Electrode. Total time required, 1 hour.

The Lincoln Engineer nearby will gladly help you find the key to improved piping with Arc Welding.

THE LINCOLN ELECTRIC COMPANY • Cleveland 1, Ohio Dept. E-2

America's greatest natural **recourse**

ARC WELDING

2000°
1500°
1000°
500°
0°

HIGH TEMPERATURES

...as they affect the properties and usefulness of metals

A metal's fitness for high-temperature use is usually measured by two yardsticks:

1. *Its continued resistance to oxidation*
2. *Its retention of strength and hardness*

Getting a good rating on one of the two counts isn't enough. To be thoroughly satisfactory for most heat resisting uses, a metal must get a high mark on both.

High original strength alone doesn't matter much if a metal oxidizes and scales, thus reducing in cross-section, or if intercrystalline change saps its vitality. Also, in many applications the scale that flakes off is a complicating factor.

On the other hand, an oxidation-resistant metal that is too soft or weak to stand up under its required load in the high temperature range is out from the start.

Tests for High-Temperature Service

The oxidation resistance of a material is measured in terms of freedom from scaling and intercrystalline attack. Its mechanical properties are evaluated principally by a series of tests which determine creep strength, endurance limit, impact strength, stress to rupture, short-time tensile strength, and hot hardness. All these seven characteristics together determine the limiting service temperature for a metal or alloy.

The INCO Nickel Alloys get a high mark on all these high temperature tests. The limiting service temperatures of four widely-used INCO metals are shown in the accompanying table (at left).

Limiting Service Temperatures—°F.

Material	Sulfur-free Atmospheres			Sulfurous Atmospheres			
	Oxidizing	Reducing H	Reducing CO	Steam	Temperature Below Which These Materials May Be Used**		Temperature Above Which These Materials Cannot Be Used
					Oxidizing	Reducing	Oxidizing	Reducing
Monel	1000	2000	1500†	800	Up to 600	Up to 500‡	1000	650
Nickel	1900	2100	2100	800	Up to 600	Up to 500	1000	700
"D" Nickel	1650	2100	2100	‡	600	*	1000	‡
Inconel	2000	2100	2100	1100†	1500	1000	1500	1000

† Estimated.
** These materials should not be used above the recommended minima temperatures without consulting INCO.
‡ Monel is not recommended for use in contact with crude oils containing sulfur at temperatures above 500° F.
* No experience at higher temperatures.
‡ Insufficient practical data to date. Applications approaching upper temperature limit should be referred to The International Nickel Co., Inc., for specific recommendations.
* Inconel and "D" Nickel are superior to Nickel and to Monel at all temperatures.

Dynamic Hardness of Materials at Elevated Temperatures

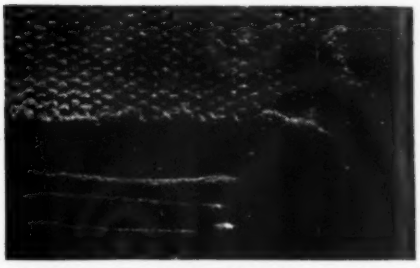
Material	Condition	Hardness Brinell Room Temperature	Dynamic Hardness* Temperature °F								Hours at 1200° F		
			Room	200	400	600	800	1000	1100	1200	2	6	26
Monel	Annealed	131	225		199	185	172		161	157	148	130	148
	Cold drawn	201	383	335	270	243	231	204	188	171	172	168	150
K Monel	Age hardened				385	358	322	311	311	331		263	256	241
Nickel	Annealed	116	201	241	174	156	149	148					
	Cold drawn	212	314	314	288	274	243	229					
Z Nickel	Age hardened	273	423	416	381	369	369						
Inconel	Annealed	172	279	263	254	241	227	219	221	216	192	199	202
	Cold worked	298	502	554	427	505	416	388	385	388	314	287	207
Monel	As cast	134	264	245	261	229	207	196	191	190	180	173	172
H Monel	As cast	203	392	377	333	333	328	327					
S Monel	Soft	268	536	515	514	467	521		595	495	528	567	531
	Age hardened	334	599		714	634	641	601	548	548	548	537	462
SAE 1020 Steel	Annealed	112	228	216	188	192	233	233	221	180†	235	176	174
SAE 1070 Steel	Annealed	161	292	272	235	221	231	241	261	256	221	194	212

† 1100° F.
* Data determined by a dynamic method of hot hardness measurement developed by the Company's research laboratory. By this method a combination of hardness and impact properties is measured on a standard specimen. The data are in terms of [illegible] Brinell numbers.

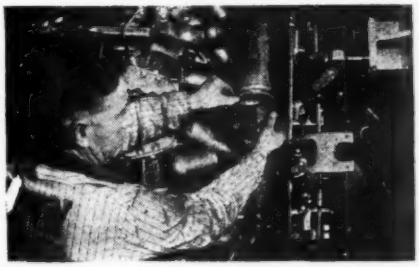
Performance in Typical Applications

Turning to practical applications, consider the use of Monel in conjunction with asbestos in insulation for new naval turbines. Here, the problem was to "reinforce" asbestos and prevent its shivering to pieces from the incessant vibration of giant turbines operating at temperatures up to 850° F.

After experimentation, Johns-Manville engineers devised an asbestos yarn with a Monel core, made of 2 Monel wires .007" in diameter, twisted together. Woven into cloth, the asbestos-Monel combination provided durable insulation that withstands both sea-air corrosion and high temperatures.



CLOSE-UP OF MONEL-ASBESTOS *cloth, devised by Johns-Manville, used to insulate naval turbines. Each thread consists of doubled .007" Monel wires, twisted with asbestos. Monel withstands corrosive sea air...incessant vibration...temperatures up to 850°F.*



INCONEL MESH PACKING *(sometimes combined with asbestos) was originally developed for sealing the high-temperature joints along the exhaust lines of airplanes. This packing withstands temperatures ranging up to 2,000° F., corrosive exhaust fumes and incessant vibration. Photo shows mechanic installing Inconel mesh packing in exhaust joint of a B-29 Superfortress. (Photo, courtesy of Boeing Aircraft Company.)*

* * *

A similar combination of asbestos and Inconel provides resilient packing which resists high temperature and corrosion by gases, alkalies, and most acids. Used now for packing exhaust lines of warplanes... where it forms a flexible cushion between vibrating joints while sealing in the white-hot gases... this composite packing offers designers and engineers high-temperature packings for possible use in post-war power installations.

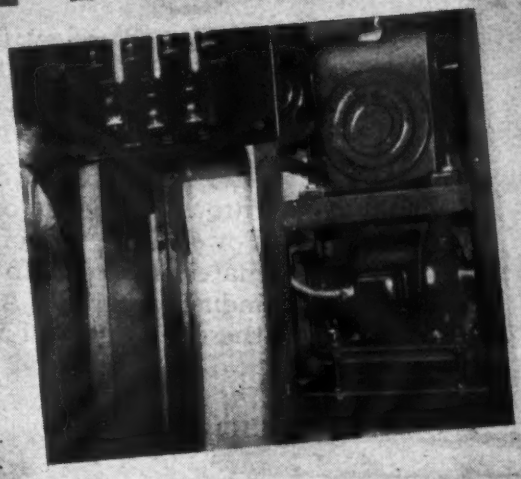
You will find valuable information about High Temperatures and other properties of metals in the bulletin "The Technical Editor Speaks." For a copy, address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET NEW YORK 5, N. Y.

IN STUFFY SPOTS

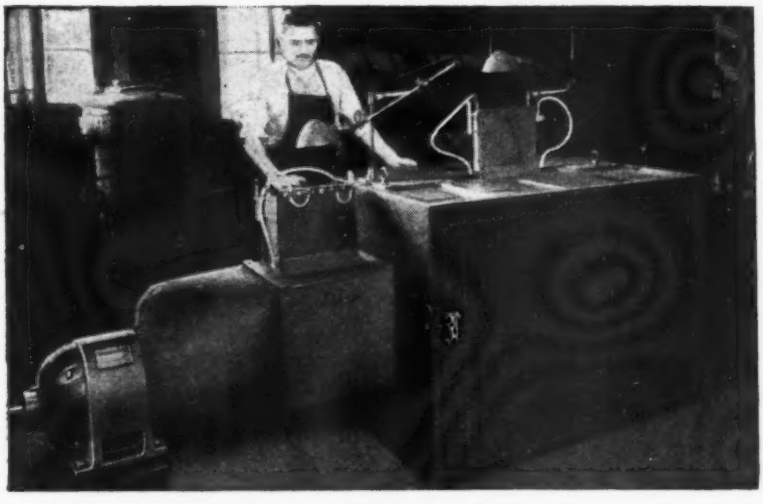
Many a motor must be located where walls, adjacent equipment, or materials cut down the free flow of air. Sometimes, as in the case of this wool-dryer drive, surroundings are hot, and stuffy, too.

Tri-Clad motors have proved themselves cool-running even under such conditions. Their powerful, double-end ventilating system moves the air at controlled velocity for effective heat removal. The location and baffling of dual exhaust ports discourage recirculation.



Tri-Clad motor drives conveyor on wool dryer—Bigelow Sanford Carpet Co., Amsterdam, N. Y.

AIR-FLOW TESTS OF TRI-CLAD MOTORS LEAD TO PROTECTION FROM OVERHEATING



Plenum chamber test of Tri-Clad motor ventilation at G-E motor factory.

Before new types or sizes of Tri-Clad motors are approved for production, plenum chamber tests are conducted on the ventilating systems of sample models. These measurements serve as a check on previous calculations of the volume and velocity of air through the motor under different conditions. Other tests under load within enclosures and at abnormal ambient temperatures are also made. If your motors must be confined in stuffy spots, G.E. can help you make the right choice to beat the heat. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

TRI-CLAD MOTORS

Buy all the BONDS you can—*and keep all you buy*

The light is always

At Powell, scientific study, research and experimentation *never* STOP. That's why Powell Engineering has always been able to solve the intricate flow control problems imposed by new products and processes.

Add to this our non-stop application of lessons learned through 99 years of practical experience and you have the Powell Line—a complete line of valves of every type and material needed to satisfy all flow-control requirements of industry today. And tomorrow, as new demands arise, there'll be Powell Valves to meet them.

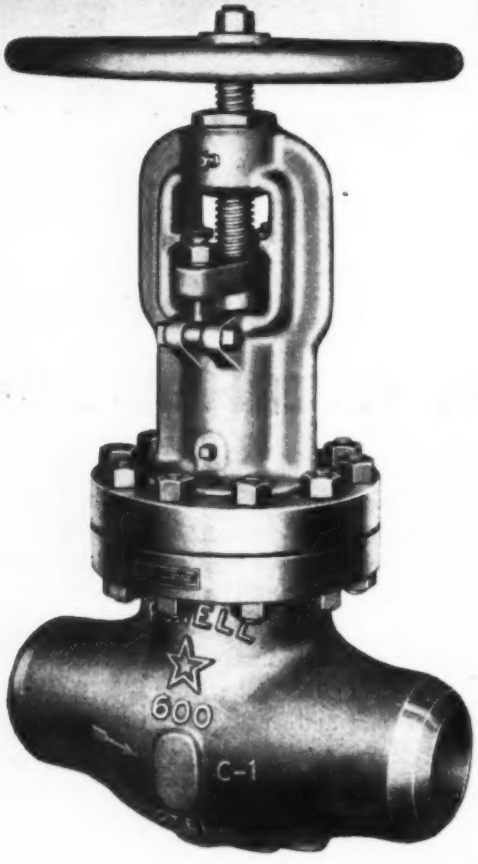


Fig. 6031 WE—Class 600-pound Cast Steel Globe Valve, with welding ends, outside screw rising stem and bolted flanged yoke.

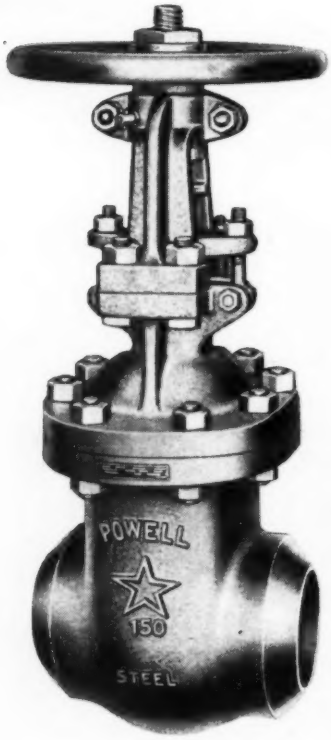


Fig. 1503 WE—Class 150-pound Cast Steel Gate Valve, with welding ends, outside screw rising stem, bolted flanged yoke and taper solid wedge.

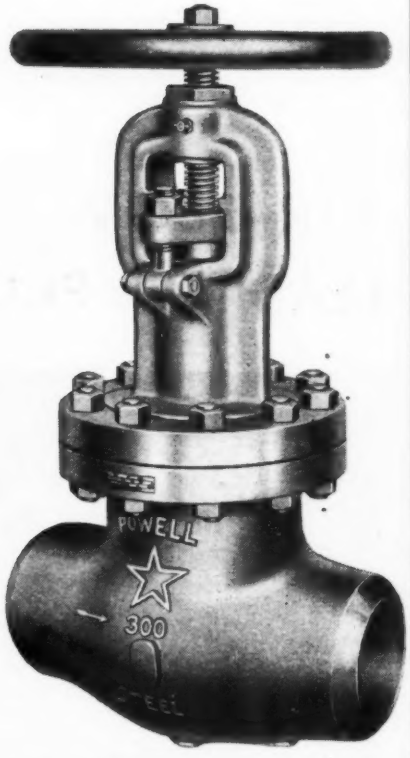


Fig. 3031 WE—Class 300-pound Cast Steel Globe Valve, with welding ends, outside screw rising stem and bolted flanged yoke.

POWELL

green at POWELL

The valves shown on this page are examples of the Powell Line of Iron Body Bronze Mounted Valves of all types, especially adapted for the control of low pressure steam, oil, water or gas.

Shown on the opposite page are a few of the complete line of Cast Steel Valves developed by Powell Engineering to handle the high pressures and temperatures of the modern power plant. This line includes valves of all types for every working steam pressure from 150 to 2500 pounds.

Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W.S.P. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Also available with taper wedge double disc—Fig. 1444.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

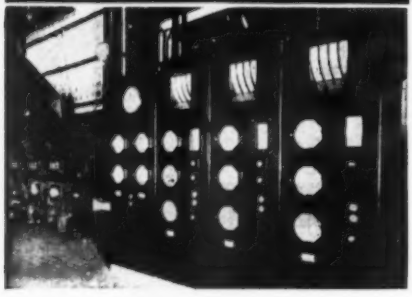
Fig. 256—Iron Body Bronze Mounted Globe Valve for 250 pounds W.S.P. Has flanged ends, outside screw rising stem, bolted flanged yoke, and regrindable, renewable bronze seat and disc.

VALVES

Install

REPUBLIC INSTRUMENTS and CONTROL EQUIPMENT

COMBUSTION CONTROL



All Sizes of Boilers All Types of Firing

Low steam costs are the result of high boiler efficiency. Daily performance at test efficiencies will result from the installation of a Republic combustion control system. They are designed for all sizes of boilers and all types of fuel firing equipment.

CONSTANT STEAM PRESSURE

Automatically maintains a constant steam pressure by controlling the fuel and air input to the boilers in balance with the boiler load.

EFFICIENT COMBUSTION

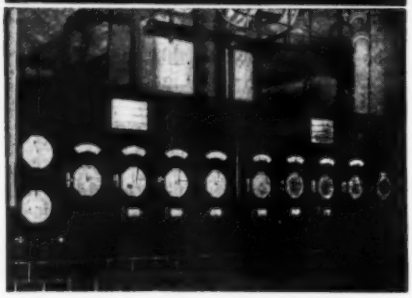
Automatically maintains maximum combustion efficiency over entire range of boiler rating, by controlling simultaneously the fuel and air input to boiler in measured proportions and in a fixed ratio.

LOAD DISTRIBUTION

Automatically distributes load equally among all the boilers, or the load can be distributed between the boilers as desired.

WRITE FOR DATA BOOK No. S-21

FLOW METERS



For Measuring the Flow of Steam-Water-Gas-Air-Oil

Do you have a means for easily and quickly checking the production and distribution of these power plant services? Do you know how much you are paying for steam or how economically it is being used? Republic flow meters will give you all the production and maintenance information you need in order to detect leaks and improve methods.

WORKING PRESSURES

Republic meters are available for all working pressures up to 5000 lb. per sq. in.

RANGE EASILY CHANGED

The range of a Republic meter can be easily and quickly changed by merely changing the range tube.

READING INSTRUMENTS

The Republic indicator, recorder and integrator operate independently of each other and can be supplied separately or in combination. They are remote reading.

EASILY READ

The indicator scale and the recorder chart all have uniform graduations and are direct reading. The integrator has a large cyclometer type dial.

WRITE FOR DATA BOOK No. 701

BOILER INSTRUMENTS

Eliminate Guesswork in Boiler Operation

Republic boiler instruments provide the operator with continuous performance records, which are the only reliable guide to efficient boiler operation.

STEAM FLOW METERS

Remote-reading indicators, recorders and integrators measure flows of steam and feedwater.

BOILER METERS

Records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

DRAFT INSTRUMENTS

Indicating and recording types in single or multiple units for all pressure or draft ranges.

CO_2 METERS

These instruments continuously indicate and record per cent CO_2 in flue gas measured by the Orsat method.

THERMOMETERS

Long-distance expansion-type thermometers with single or multiple pen recorders.

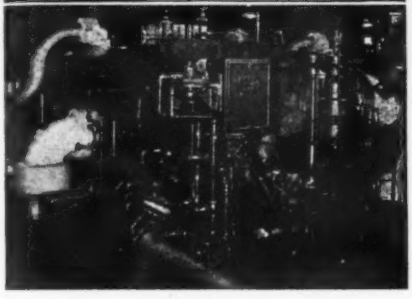
WRITE FOR BOILER METER DATA

REPUBLIC
INSTRUMENTS
AND CONTROLS

TO INCREASE Today's Steam Production

TO DECREASE Tomorrow's Steam Costs

REGULATORS



For Controlling Pressure Flow-Level-Speed

Republic regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

SENSITIVITY

Republic regulators can be made sensitive to changes of less than 0.001 inch of water.

SPEED

Republic regulators can be made to meet any speed requirement up to one full stroke in 2.4 seconds.

STABILITY

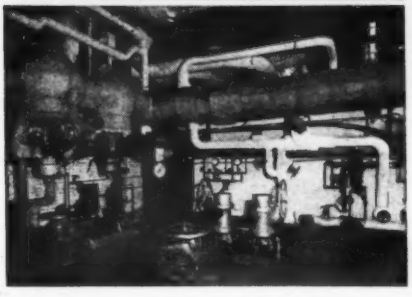
The patented Republic stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

POWER

Standard Republic power cylinders will deliver from 360 to 5600 foot pounds per stroke.

WRITE FOR DATA BOOK No. S-13

DESUPERHEATERS



Designed to Meet Your Special Requirements

Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with the rugged, simply-controlled Republic desuperheaters described below.

RATIO TYPE

This desuperheater is a self-supported venturi in which the desuperheating water, completely evaporated at all flows, is controlled by the steam flow in the correct proportion to reduce the steam temperature to the required value.

RATIO TANK TYPE

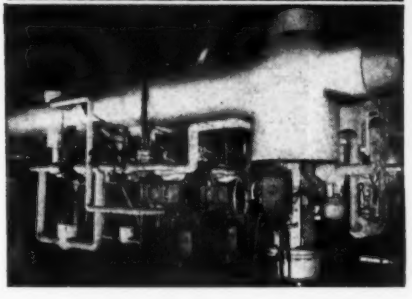
This unit is similar to the ratio type except that a water tank is added to give emergency water reserve.

STEAM ATOMIZING TYPE

In this desuperheater, built for extremely wide range operation and zero pressure loss, the desuperheating water is completely atomized at all rates of flow by a small quantity of high-pressure steam.

WRITE FOR BULLETIN No. S-30

VALVES



Regulating and Pressure Reducing

For your key jobs, where valves must not fail—where they must continuously and accurately regulate the pressures and flows of steam and water on which other vital processes depend—Republic valves give you the dependability you need.

ANY STEAM CONDITIONS

These valves are of the gradual-opening, high-lift, double-seated type, lever or hydraulic-operated, built to A.S.A. standards for steam conditions up to 1500 lb. per sq. in., 950 F and capacities up to 1,000,000 lb. of steam an hour.

STABLE REGULATION

Republic valves will regulate accurately from maximum flow down to 2 per cent of maximum.

CUSTOM MADE CONSTRUCTION

Republic valves are built for any piping condition, with inlet and outlet sizes proportioned for specific pressure reductions. Special steels are used, depending on service requirements.

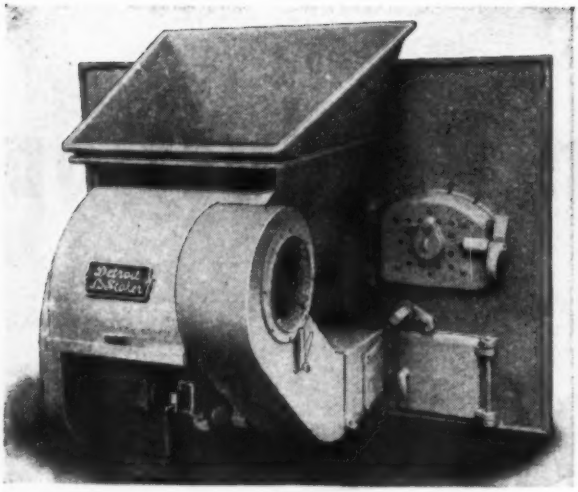
ONE-PIECE STEM

Valve stem and discs are machined from a single stainless steel forging.

WRITE FOR BULLETIN No. S-40

Republic Flow Meters Co.

2240 Diversey Parkway • Chicago 47, Illinois



DETROIT LOSTOKER (BRICK-SET TYPE)

LOSTOKER HAS LARGE ACTIVE GRATE AREA TO FIT THE FURNACE

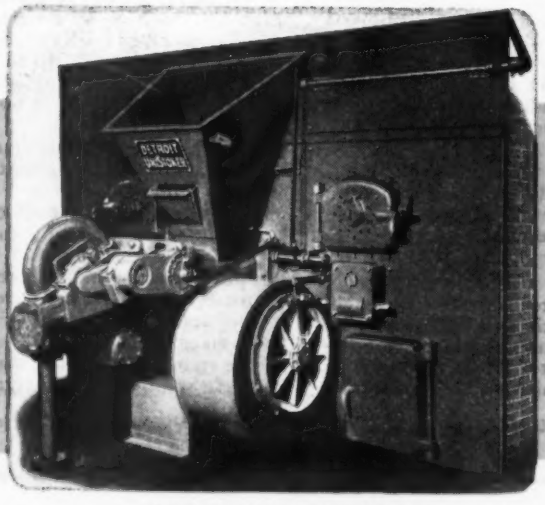
If IT'S A SIDE CLEANING UNDERFEED STOKER

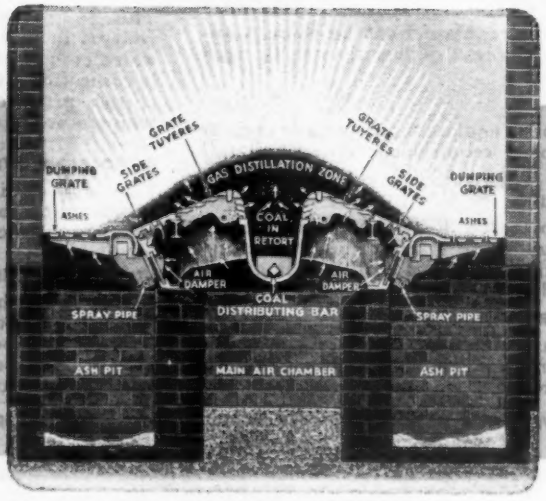
DETROIT LOSTOKER

For approximately 50 to 150 horsepower boilers provides adjustments for coal feed and distribution. Brick-set application for tubular or water tube boilers, built to fit the furnace. When applied to high firebox boilers, no front or side wall brickwork is required. Automatically controlled—a great coal saver.

DETROIT UNISTOKER

Readily applied to existing or new boilers of approximately 125 to 300 horsepower. Detroit Adjustable Feed, (coal feed control) is synchronized with the air supply to insure best economy over a wide range of capacities. Uni-Stokers may be motor or steam turbine driven. Thousands in daily operation.





DETROIT UNISTOKER—with full housed blower mounted at stoker front is a compact, efficient unit type

DETROIT STOKER COMPANY

We have it!

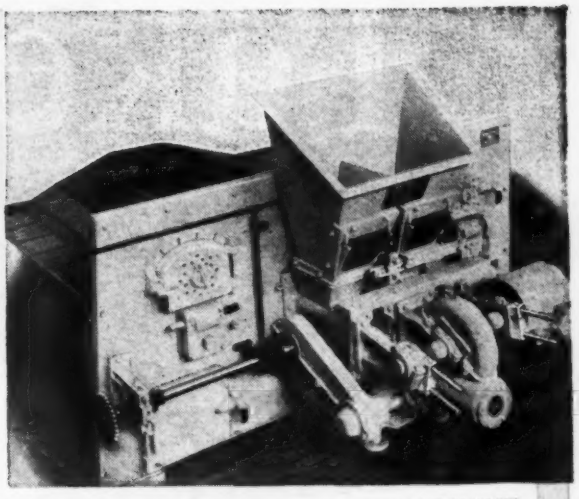
MANY SIZES AND CAPACITIES FOR ALL BOILERS . . .

DETROIT DOUBLE RETORT STOKER

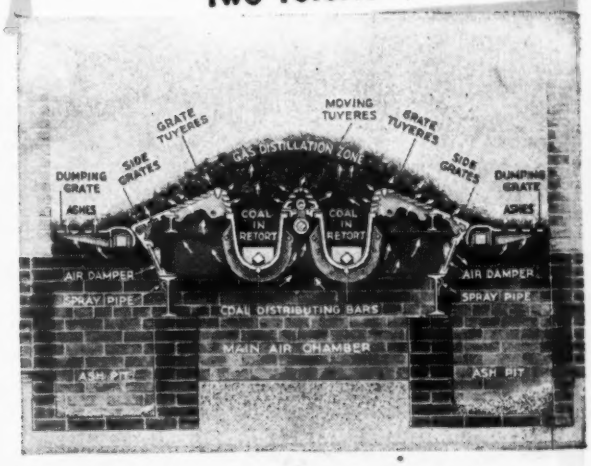
Designed especially to meet difficult installation problems and to provide a high capacity, heavy duty stoker for boilers of medium size where conditions prevent the use of a basement for ash removal. Also mechanically driven through machine-cut worms and gears, the Detroit Double Retort Stoker requires little power for operation.

DETROIT UNISTOKER

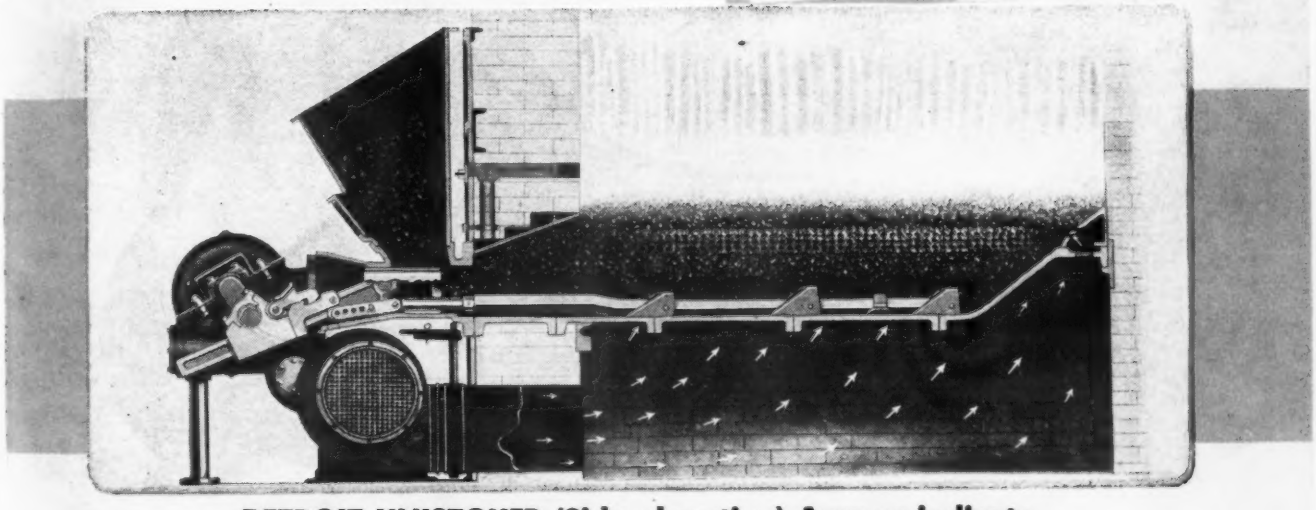
In UniStoker operation the fuel is introduced by the dependable plunger-feed system and penetrated by many air streams as it rises in the retort. As the fuel cokes and burns, the ash moves sideways over inclined grates to the dumping grates. The side cleaning feature eliminates disturbing the active fuel bed when cleaning fires. Ash removal through doors in stoker front.



DETROIT DOUBLE RETORT STOKER —is a multiple Retort stoker of two retorts



DOUBLE RETORT is readily adapted to existing boilers because of the side cleaning feature



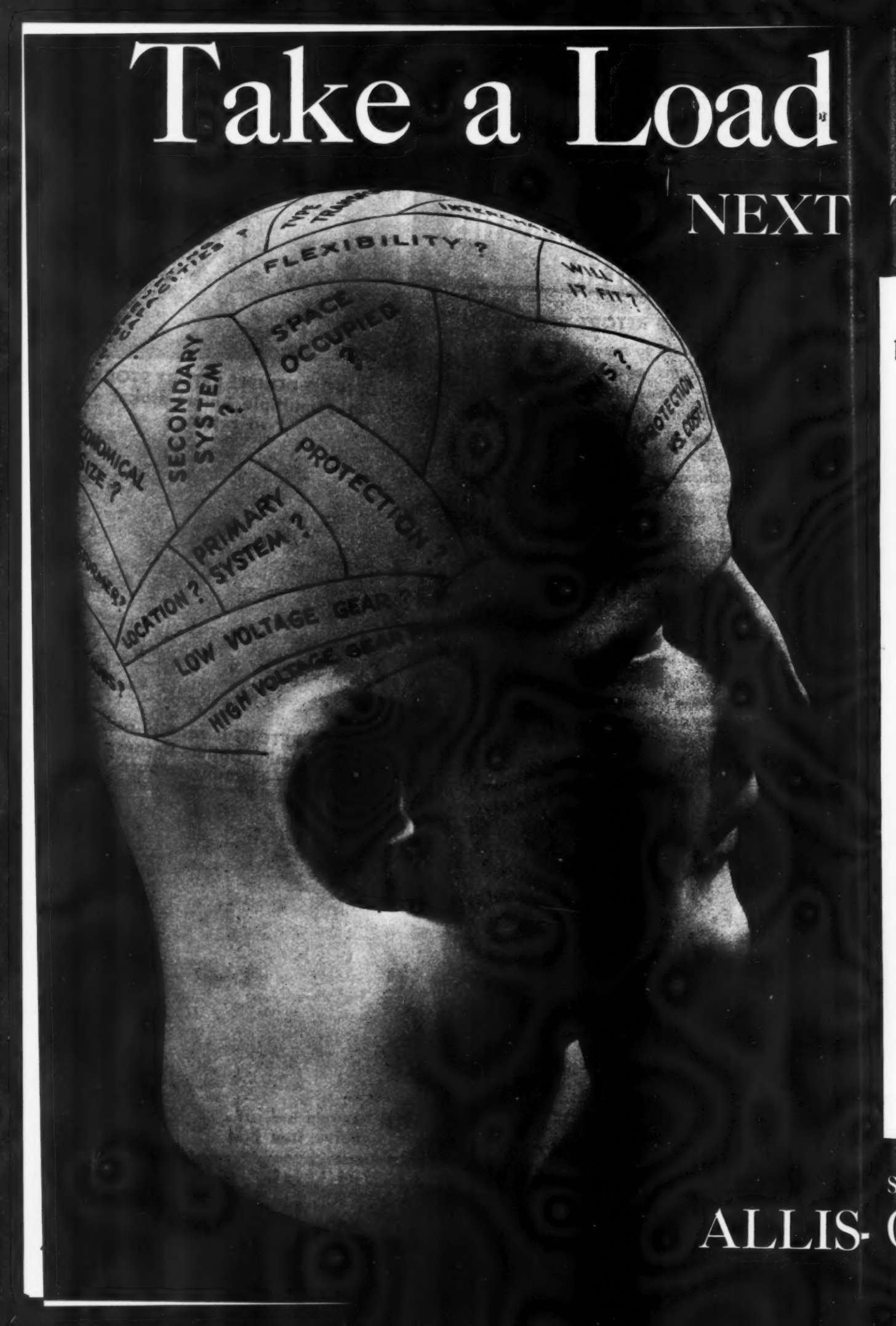
DETROIT UNISTOKER (Side elevation) Arrows indicate flow of air to all parts of the large active fuel bed

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

Take a Load

NEXT

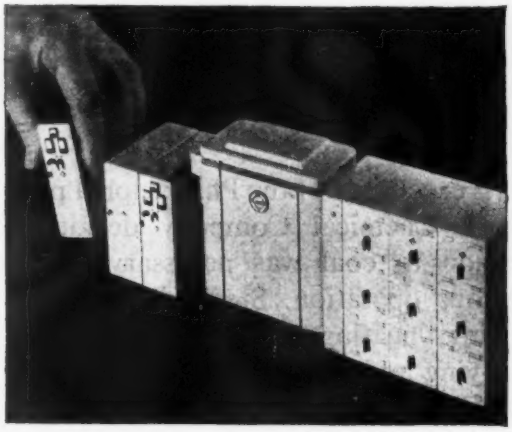


ALLIS-

off Your Mind

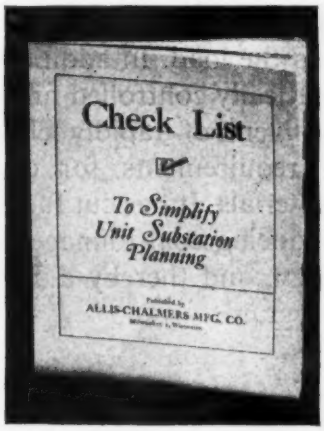
TIME YOU PLAN UNIT SUBS!

See how headaches disappear as you work out power distribution problems with Allis-Chalmers' new "Unit Sub Builder" Set! It's no toy, no stunt... but an *engineered* time- and trouble-saver!



1 **YOU SEE WHAT'S AVAILABLE** — without bogging down in charts, tables, catalogs. For a demonstration of the new unit sub models by an A-C field engineer, call your nearby Allis-Chalmers office. No obligation, of course.

2 **YOU EXPERIMENT**—Unit sub arrangements are assembled quickly. . . allowing easy comparison of alternate plans. You'll find models idea-stimulating.



3 **NEW SLIDE RULE** for figuring breaker interrupting capacities will save you time, trouble.

4 **YOU VISUALIZE SOLUTIONS** to your distribution problems *on the top of your desk*. You see what space the right unit sub will occupy, how it will actually look.

5 **HANDY "CHECK LIST"** provides a *double* check. Allis-Chalmers, Milwaukee, Wisconsin.

A 1748

SEE YOUR UNIT SUB IDEAS WORKED OUT WITH

S- CHALMERS *"Unit Sub Builder" Set*

Vick Chemical converts to IRON FIREMAN

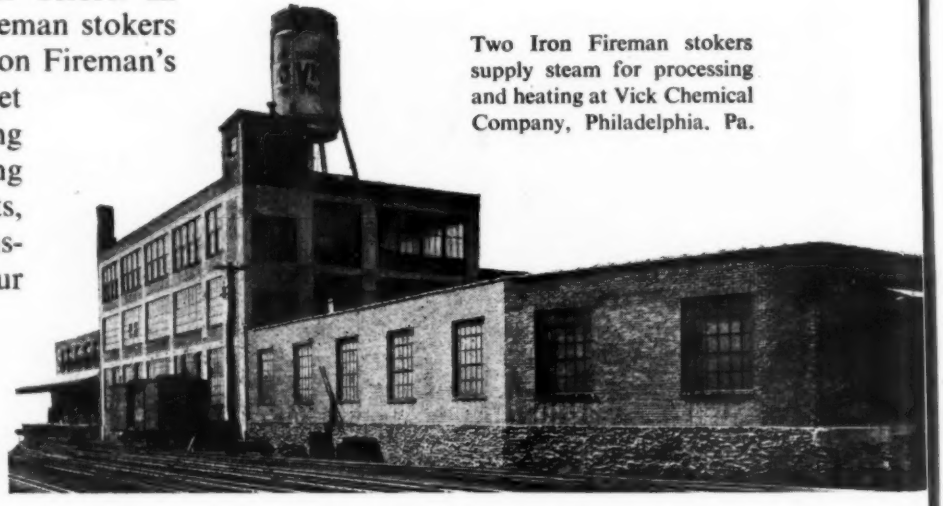
Averts Threatened Fuel Shortage

THE executives of the Philadelphia plant of Vick Chemical Company decided that conversion to coal was necessary to insure continuous operation. Steam is required for processing, heating water, air conditioning, humidifying and heating the building.

Iron Fireman automatic coal stokers were installed in August, 1942. Record cold weather this past winter made the heating load larger than usual, and steam requirements for manufacturing were greater than ever before. In spite of these increases, Iron Fireman stokers handled the load. In addition, Iron Fireman's automatically controlled firing met the problem of rapidly changing steam requirements for cooking raw materials. It has cut fuel costs, thus reducing coal tonnage, transportation, and thereby aiding our war program.

Easy to Change to Iron Fireman Coal Firing

If you are faced with fuel changes or increased steam loads, find out how quickly Iron Fireman equipment can be installed. Iron Fireman engineers are ready to make an immediate survey of your steam plant. No obligation. Iron Fireman Manufacturing Company, Portland, Oregon; Cleveland, Ohio; Toronto, Canada.



Two Iron Fireman stokers supply steam for processing and heating at Vick Chemical Company, Philadelphia, Pa.

IRON FIREMAN

Automatic Coal Stokers

Sufficient space was not available at the front of the boiler and the Iron Fireman stoker was installed through the side of the furnace.

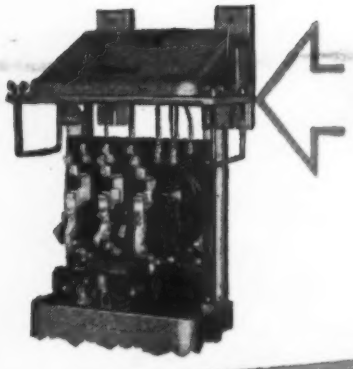
"Our Iron Fireman automatically controlled coal stokers now handle a rapidly fluctuating load that is even larger than the demand which was carried by our former firing system."

JAMES WOOD
Superintendent
Vick Chemical Co.

JAMES WOOD, Superintendent at the Vick Chemical Company plant.

IRON FIREMAN STOKERS ARE AVAILABLE—*Write for Information*

Output of Iron Fireman commercial and industrial stokers has been substantially increased to equip heating and power plants converting from oil, hand-fired coal and gas. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Mfg. Company, 3840 West 106th Street, Cleveland 11, Ohio.



PROBLEM: To find a durable cable for oil-immersed, motor-control connections

FIRST SOLVED WITH FLAMENOL CABLE

Eight years ago, a Virginia chemical plant faced a troublesome cable problem. The plant required insulated cable for oil-immersed, motor-control connections. Rubber-insulated cable deteriorated rapidly in the oil, and frequent replacement was necessary.

When this problem was given to the General Electric Company, G-E engineers recommended the use of Flamenol* cable. In a trial installation, Flamenol proved so successful that the customer decided to use it throughout his plant.

If you have a problem of finding insulated cable or wire that will withstand severe conditions, such as contact with oil, Flamenol may very likely be the answer. It has proved its many desirable properties in hundreds of power and lighting applications.

RESISTS FLAME

Flamenol does not support combustion—thus it prevents serious outages due to fires that involve wiring. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Flamenol strips easily and leaves the conductor surface untarnished. It is highly resistant to oils, water, mild acids and alkalis, and weather. It is tough, stable, flexible at low temperatures, and has high dielectric strength.

A G. E. "FIRST"

Only G.E. makes Flamenol wire and cable. Plasticized polyvinyl chloride, the insulation on Flamenol, was pioneered by G.E. and introduced in 1935—not as a "substitute" for rubber insulation, but as a new type possessing desirable properties not available in rubber. To find out how Flamenol can help solve your problems—save you time, trouble, and expense—ask our local office, or write General Electric Company, Schenectady 5, N. Y.

*Trade-mark Reg. U.S. Pat. Off.

GENERAL ELECTRIC

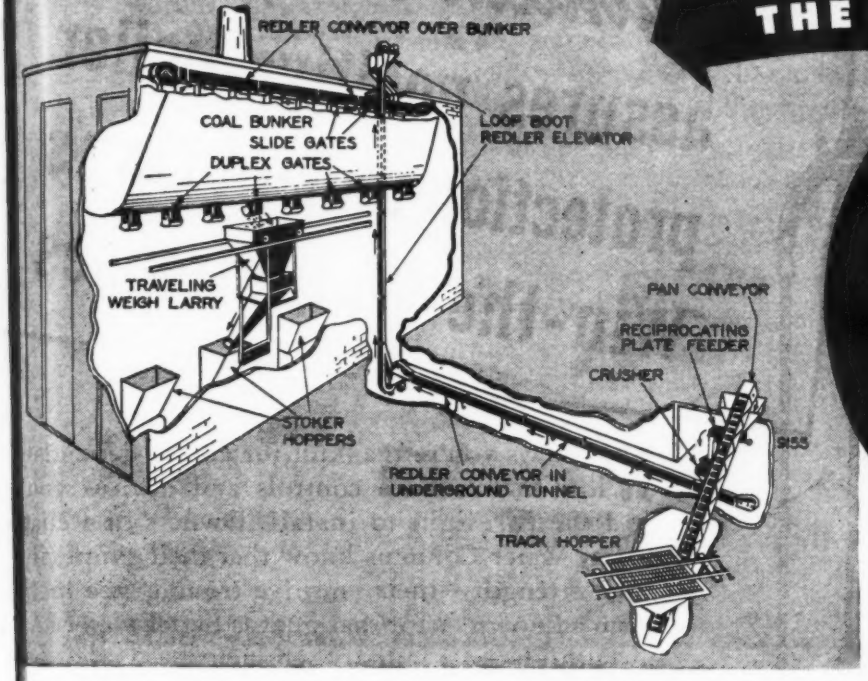
505-50-1200

Buy all the BONDS you can—and keep all you buy

The Problem—
Handle Coal through 7 operations!
unload – crush – convey – elevate – store – reclaim – weigh

THE S-A ANSWER

Cut Handling Costs *at Every Stage*



Diagrammatic view of the S-A Coal Handling System at centralized boiler plant. Track Hopper, Pan Conveyor, Feeder, Crusher, REDLERS, Gates, Traveling Weigh Larry, are all designed and built by S-A.

View above coal bunker showing S-A REDLER Conveyor distributing coal full length of bunker. S-A Traveling Weigh Larry feeds coal from any part of bunker to any stoker hopper.

When a large state institution decided to centralize several boiler rooms into one power plant, it went all the way with a modern efficient handling system. Today, S-A equipment handles coal automatically through 7 operations.

This plant is a model of efficiency, low cost handling and cleanliness. The key to the solution is the system of REDLER Conveyors and Elevators. For REDLERS, using the *en masse* principle, require little space . . . having sealed casings, they eliminate dust and dirt.

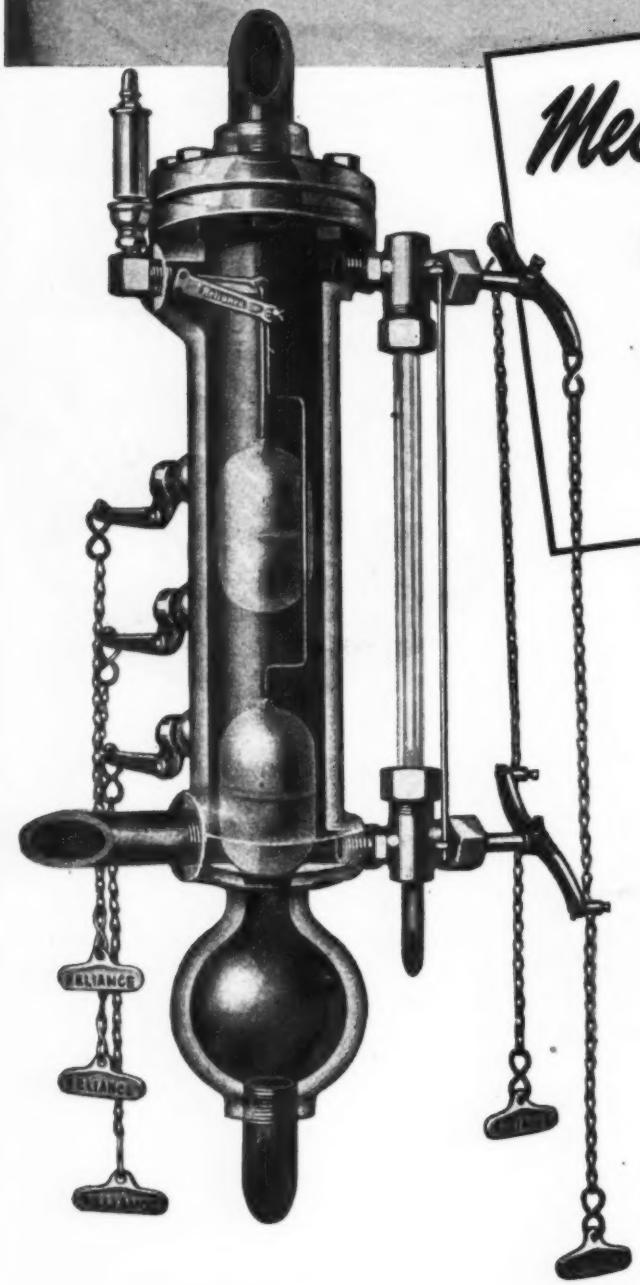
Together with other S-A units, REDLERS make this an outstanding example of mechanical handling. Write for copy of REDLER Conveyor Catalog No. 140.

STEPHEN S-A ADAMSON MFG. CO.

RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

Why the Reliance Safety Water Column is



Mechanical Simplicity

assures positive boiler protection under today's "Win-the-War" stresses

Nowadays you're thankful for all the dependabl low maintenance controls and devices you' had the foresight to install. Owners of Relian Safety Water Columns know that their simplicity their strength—their sensitive trouble-free mech nism a known factor that guards boiler water leve as faithfully as a military sentinel.

Action of the ALARM is direct and foolpro There's nothing to adjust or get out of order in t operating mechanism, which is high in the colum safe from scale, sediment and corrosion. When wat level falls below a safe normal, weight of the ala float pulls open the whistle valve—the warning ca operators, helps prevent burned out tubes, crack headers, bulged sheets and serious explosions.

When water rises above a predetermined poi high alarm float is buoyed up, opening whistle val to warn against the chance of priming or slugs water carried over to damage engine or turbine.

You can be sure of maximum service from R liance Alarms if simple installation instructions ha been followed. We recommend that you check ca

Since 1884

Reliance

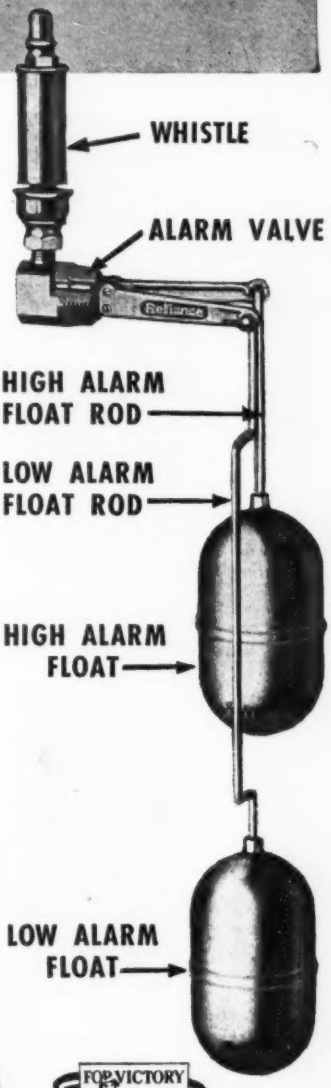
BOILER SAFETY DEVICES

is Vital to your busy War Production

fully the A. S. M. E. and local Code requirements and compare your hook-up with their rules. Be sure all connections run straight. Provide for cleaning by installing crosses with plugs at all right-angle turns as pipe and fittings often stop up with scale and sediment. Complete instructions for installing the column and replacing its parts are covered in Reliance Form Number 429.

Long wear, or unusual accidents while cleaning column and piping may necessitate some replacement of parts. As you probably know, you can order maintenance parts on an MRO priority. It will be helpful if you refer to *Reliance Replacement Parts Order Blank, Form 392-A*— or write for a copy—to give you the correct parts names. Always state the catalog number of your Reliance Column, which you find on the sediment chamber or on number plate.

The importance of insuring positive water level supervision through the Safety Water Column and adequate Gage Equipment is recognized by all competent engineers. . . . To keep up-to-date on construction facts write for latest Reliance Alarm Catalog 414.

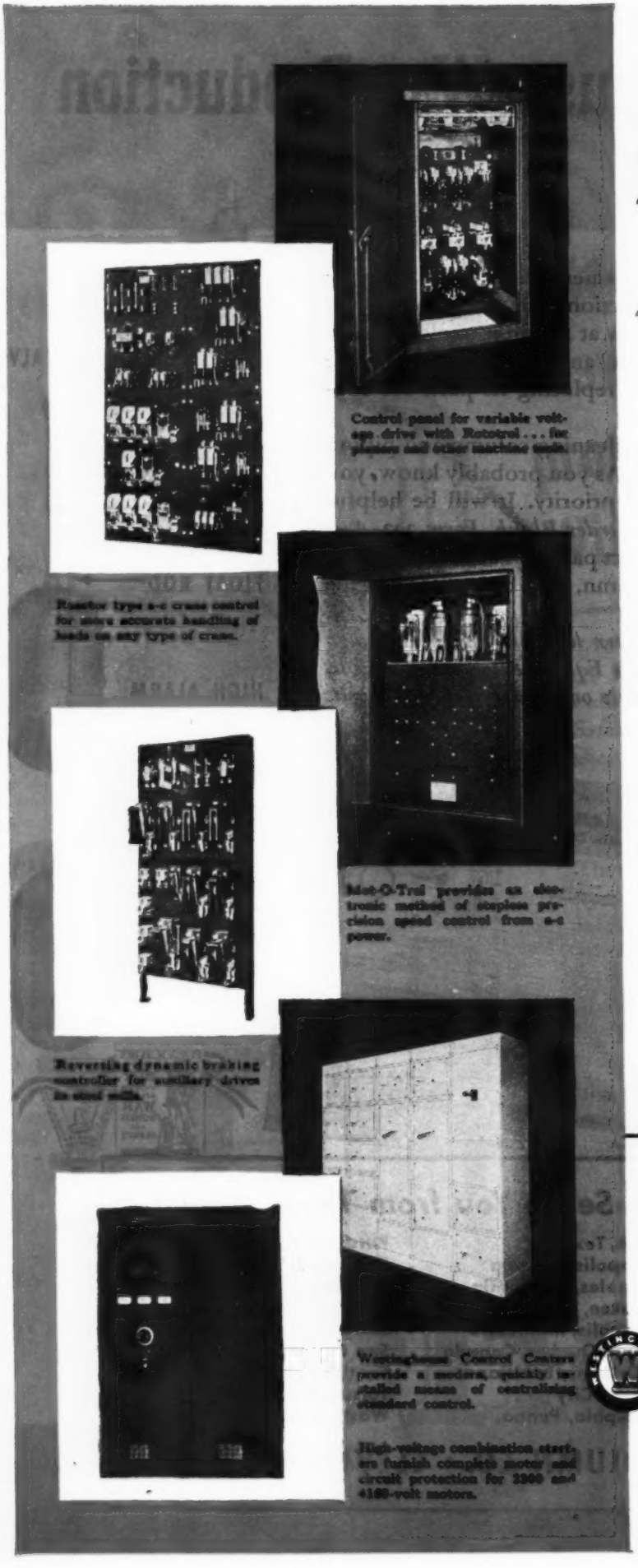


RELIANCE BOILER ALARMS
(Safety Water Columns)
FOR SAFE, SURE CONTROL OF BOILER WATER LEVELS
The Reliance Gauge Column Company
CATALOG 414
How to Install the Reliance Alarm Water Column
Reliance Alarm Replacement Parts Order Blank
THE RELIANCE GAUGE COLUMN CO.

Reliance Representatives Serve You from These Cities:

Atlanta, Georgia	Houston, Texas	Pittsburgh, Penna.
Birmingham, Alabama	Indianapolis, Indiana	Richmond, Virginia
Boston, Massachusetts	Los Angeles, California	Rochester, New York
Buffalo, New York	Milwaukee, Wisconsin	St. Louis, Missouri
Charlotte, North Carolina	Minneapolis, Minnesota	Salt Lake City, Utah
Chicago, Illinois	Montreal, Quebec, Canada	San Francisco, California
Cincinnati, Ohio	New Orleans, Louisiana	Seattle, Washington
Denver, Colorado	New York City	Tulsa, Oklahoma
Detroit, Michigan	Philadelphia, Penna.	Washington, D. C.

THE RELIANCE GAUGE COLUMN CO. • CLEVELAND, OHIO

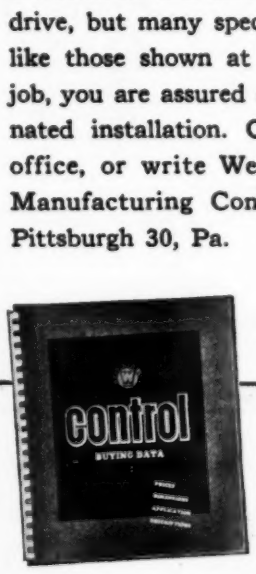

Control panel for variable voltage drive with Rototrol . . . for planers and other machine tools.
Reactor type a-c crane control for more accurate handling of loads on any type of crane.
Mot-O-Trol provides an electronic method of stepless precision speed control from a-c power.
Reversing dynamic braking controller for auxiliary drives in steel mills.
Westinghouse Control Centers provide a modern, quickly installed means of centralizing standard control.
High-voltage combination starters furnish complete motor and circuit protection for 2300 and 4160-volt motors.

For any Motor Control

. . . call Westinghouse

Control properly selected and applied makes it easy to put motors through their paces . . . to stand up and deliver. Application of control can be greatly simplified also by making one supplier responsible for the entire motor drive.

Westinghouse motor control not only covers the entire range of standard a-c and d-c controls and accessories for every type of drive, but many specialized types of control like those shown at left. Regardless of the job, you are assured of a completely co-ordinated installation. Call your Westinghouse office, or write Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Pa. J-60587



Selection of Westinghouse standard motor control is greatly simplified by this 290-page Buying Data book. If you do not have a copy, phone or write your Westinghouse office for Catalog 7000.

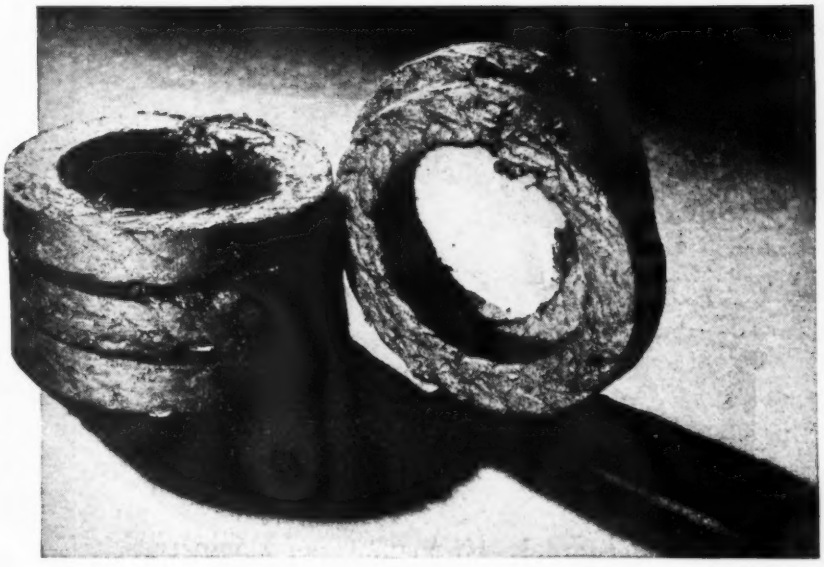
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Motor Control

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make PACKING Last Longer . . .



The *kind* of packing and *how* you use it have a lot to do with maintaining peak pumping efficiency. Here, at left, is a step-by-step outline of the correct way to install pump packing — saving you vital man-hours and money as well.

MOST PACKING TROUBLE traces back to *lack of "know-how"* in caring for stuffing boxes. This is wasteful — time and money-wise — especially since *correct* packing procedure is so simple for maintenance men to understand and practise.

Another class of trouble traces to misalignment of pump and motor. For when shaft is deflected, sleeve is apt to wobble — greatly accelerating packing wear. To eliminate this problem, A-C engineers developed, for many applications, the "Electrifugal" pump — in which both motor and impeller are mounted on *one* shaft, in *one* frame. This means fewer parts, fewer bolted connections — no chance for misalignment.

Regardless of type of pumps you use, here is an outline of correct packing procedure — plus a few tips on what to look for when trouble *does* arise . . .

▸Make certain packing is suitable for service it must perform . . . that it's the right size and made of the right materials. Be cautious of so-called "all-purpose" packings. If in doubt, check with your pump manufacturer.

▸Don't force in new packing against the old. It's apt to displace lantern ring and plug sealing liquid opening. First remove *all* old packing; clean stuffing box thoroughly; then insert new packing.

▸Put each ring of packing in separately, seating it firmly before adding the next. Stagger adjacent rings so that joints are at 180° angle to each other. If lantern rings are used, be careful that sealing liquid openings aren't blocked as new rings are installed.

▸After required number of rings have been inserted, tighten gland nuts. Gland should be taken up evenly to *finger-tightness*. If compressed too tightly, packing will burn out or sleeves become scored.

▸Finally, until shaft turns over freely, operate pump for about 1-minute intervals — permitting packing to cool. Then put it into continuous operation.

▸What to check for if packing wears too quickly — (1) Check shaft sleeves. If badly scored they grind down packing rapidly; (2) Check position of lantern ring. It may be displaced; (3) If water seal piping is used, check liquid. If it contains grit a separate source of sealing liquid should be obtained.

▸Send for your *free* copy of Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps". It's the basic, easy-to-understand guide to efficient centrifugal pump maintenance. Contains *no* advertising; applies to *all* makes. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1754

ALLIS-CHALMERS PUMPS

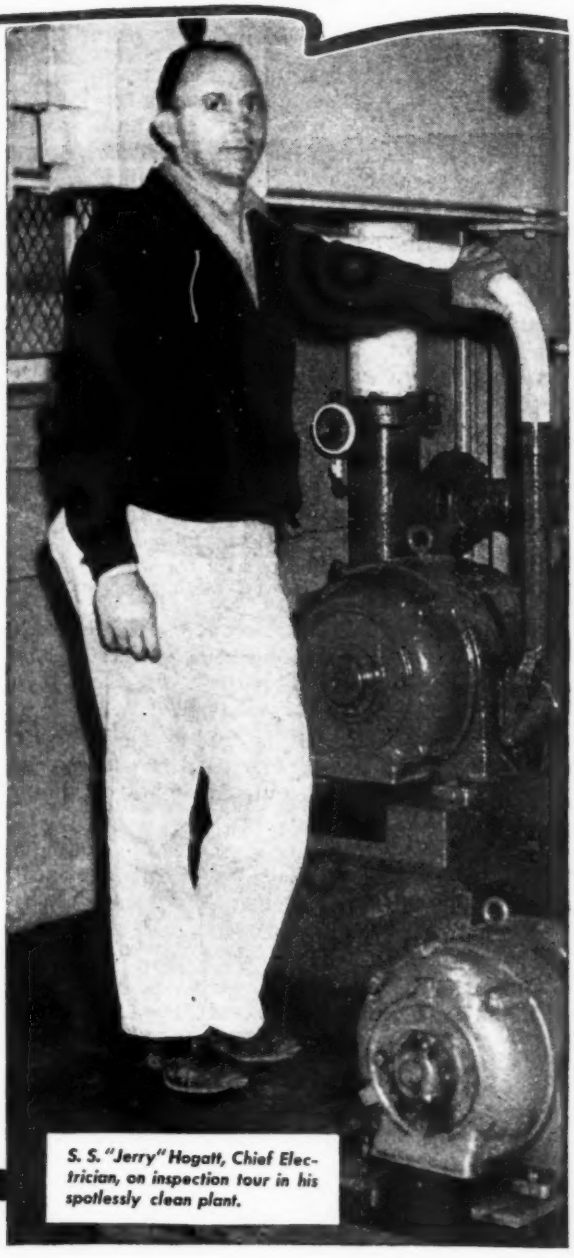
Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.

"We Put An End To Electrical Shutdowns On Our Compressor Circuits By Standardizing On BUSS Super-Lag Fuses"

—S. S. "Jerry" HOGATT, *Chief Electrician*
JACKSON BREWING CO. • NEW ORLEANS

Bernard L. Kiernan, Chief Engineer, checking operation charts in his office.

Mr. Bernard L. Kiernan, Chief Engineer of Jackson, the largest brewery in the South, amplifies Mr. Hogatt's statement with these added facts—"Our compressors and pumps formerly gave us constant trouble. Frequent fuse blowing, due to the heavy load when the compressors started, caused many shutdowns. We couldn't afford the costly experience of having our equipment out of service when we needed all the production we could get. We eliminated that problem, though, when we standardized on BUSS Super-Lag fuses. They have helped us save a lot of time, annoyance, and expense—and helped keep production up, too."



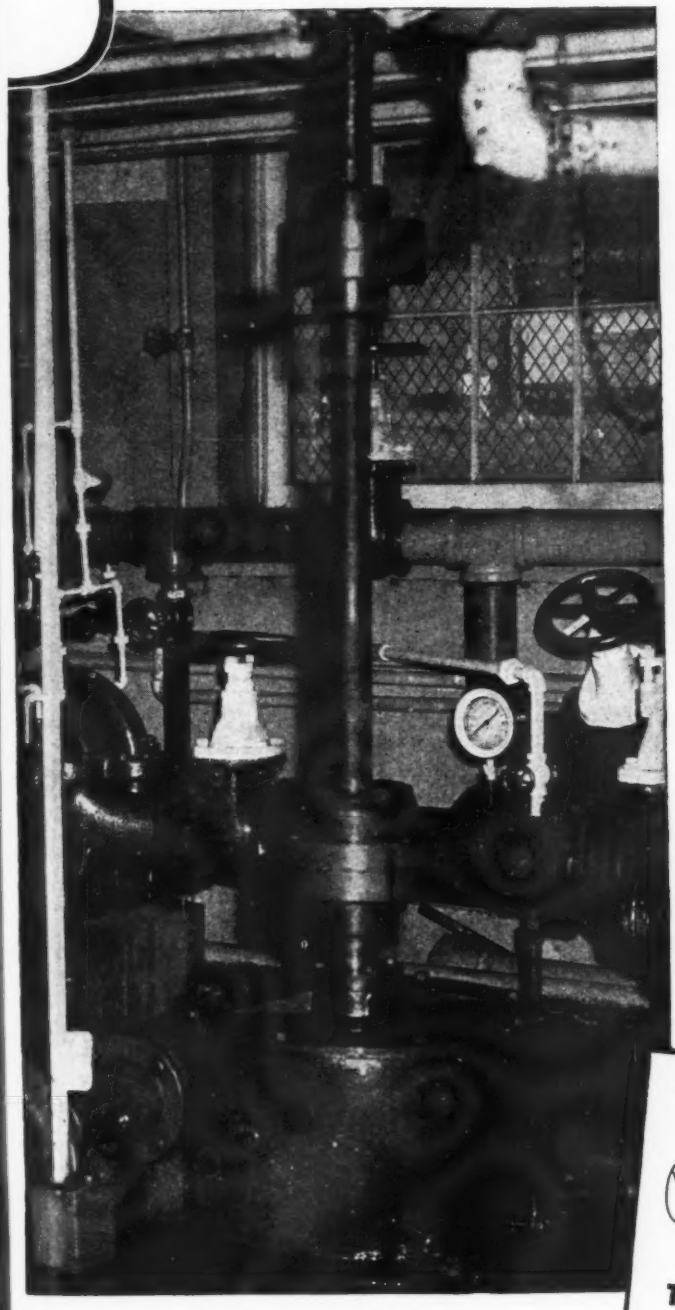
S. S. "Jerry" Hogatt, Chief Electrician, on inspection tour in his spotlessly clean plant.

BUSS *Super-Lag*

SOLD THROUGH WHOLESALERS

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.



The fuse link used is the famous "BUSS Super-Lag". It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

Prevent future trouble in your plant—by doing this today

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the care-free, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MANUFACTURING CO.
St. Louis 7, Mo.
Division McGraw Electric Company

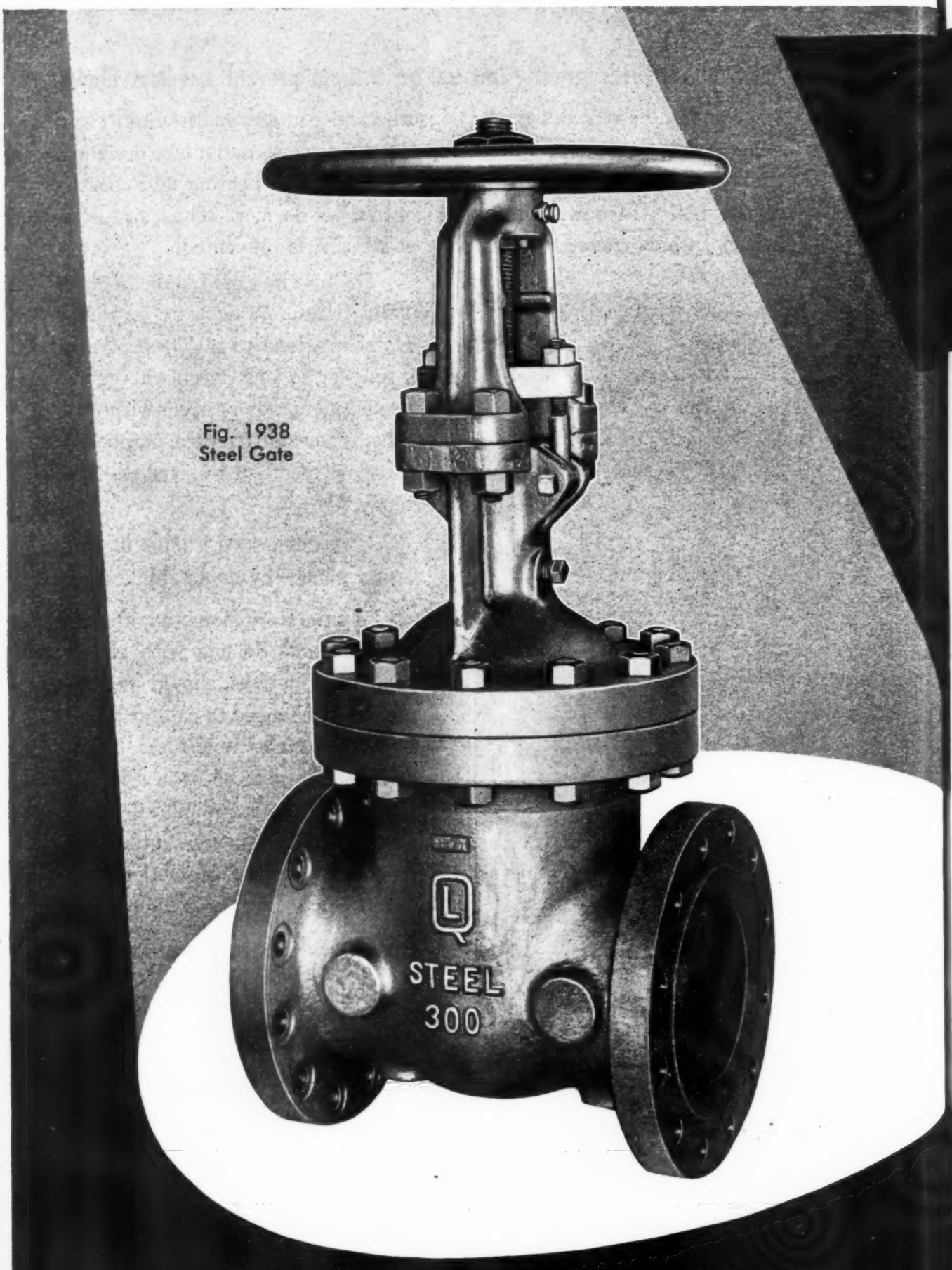
FUSES

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible

and

The **SUPER-LAG** development in the FUSE-LINK completes the job.



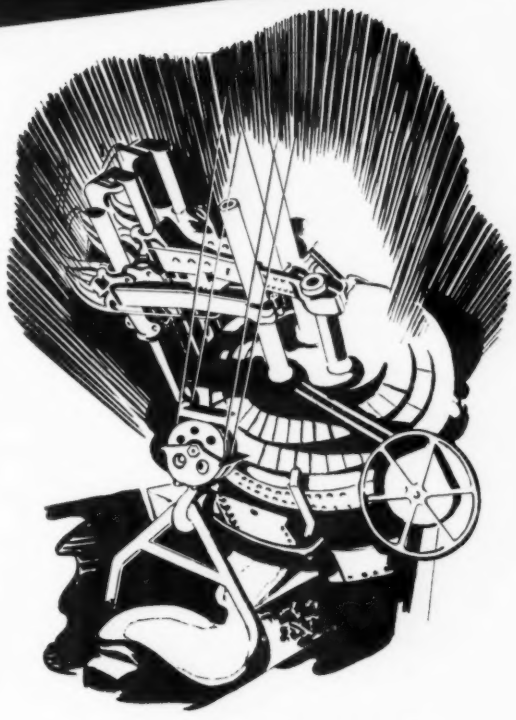
BRONZE, IRON, STEEL, AND CORROSION-RESISTANT ALLOY VALVES—125 to 2500 LB. S. P. . . .
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS.

TIGHT VALVES *Save Fuel!*

...VITALLY IMPORTANT NOW, WHEN EVERY POUND MUST BE CONSERVED . . . Many elements in a piping system may contribute to ultimate fuel waste. Insulation may be inadequate. Piping and fittings may be defective. Or *valves may fail to hold tight* . . . resulting in leakage of steam, air, or water, and in lowered pressures, all of which may mean excessive *fuel consumption.*

Lunkenheimer Valves—whether of steel, iron, or bronze—are *quality built* to *stay tight,* over years of service. They afford constant, dependable protection against leakage. Simplicity of design and a minimum of working parts assure extra long life and easy, economical maintenance.

We have prepared a chart, showing in dollars-and-cents figures, what leaky valves can waste in steam, water, and air. For a copy, write The Lunkenheimer Company, Cincinnati 14, Ohio, U. S. A.



"MAN-MADE INFERNO"

From this huge electric furnace, large quantities of molten steel are poured daily, for use in making castings for Lunkenheimer Steel Gate Valves . . . Only laboratory OK'd metals are used; formulae are rigidly adhered to; weighing is very accurately done. Heating and pouring temperatures are carefully controlled and checked. Every aid of science is used to produce metal that will uphold Lunkenheimer's reputation for fine castings.

LUNKENHEIMER VALVES

BRANCH OFFICES:
New York 13 Chicago 6
Boston 10 Philadelphia 7

EXPORT DEPARTMENT:
318-322 Hudson St.,
New York 13, New York

The Lunkenheimer Nationwide Distributor Organization is always ready to help you with your problems of operation and maintenance. There is one near you with facilities for complete service.

WHY BETZ BOILER WATER CONTROL CALLS FOR DAILY PLANT TESTS

Daily plant control is of major importance to efficient boiler water conditioning. Without it, because of varying boiler load and feedwater characteristics, costly over-treatment or dangerous under-treatment will result.

In rendering a complete and detailed supervisory service BETZ determines the boiler water testing limits to be maintained and furnishes a control chart especially prepared for each individual plant. This chart shows the plant engineer exactly what to do to maintain the most desirable softener and boiler water chemical balances. The daily chemical control tests performed at the plant enable the operator to hold the boiler water between the prescribed control limits at all times.

On the facing page there is shown a Boiler Water Control Report form on which the results of the daily plant tests are entered for the plant record. Copies of these reports are mailed to our laboratories where they are carefully reviewed and a detailed report is submitted to the plant, calling attention to any deficiencies revealed by the test record.

This dual system of daily plant testing and Betz laboratory control is one of the most important factors in the complete and individualized supervisory service for boiler water conditioning offered by the Betz organization. It is an assurance of continuously efficient boiler water treatment.

W. H. & L. D. BETZ

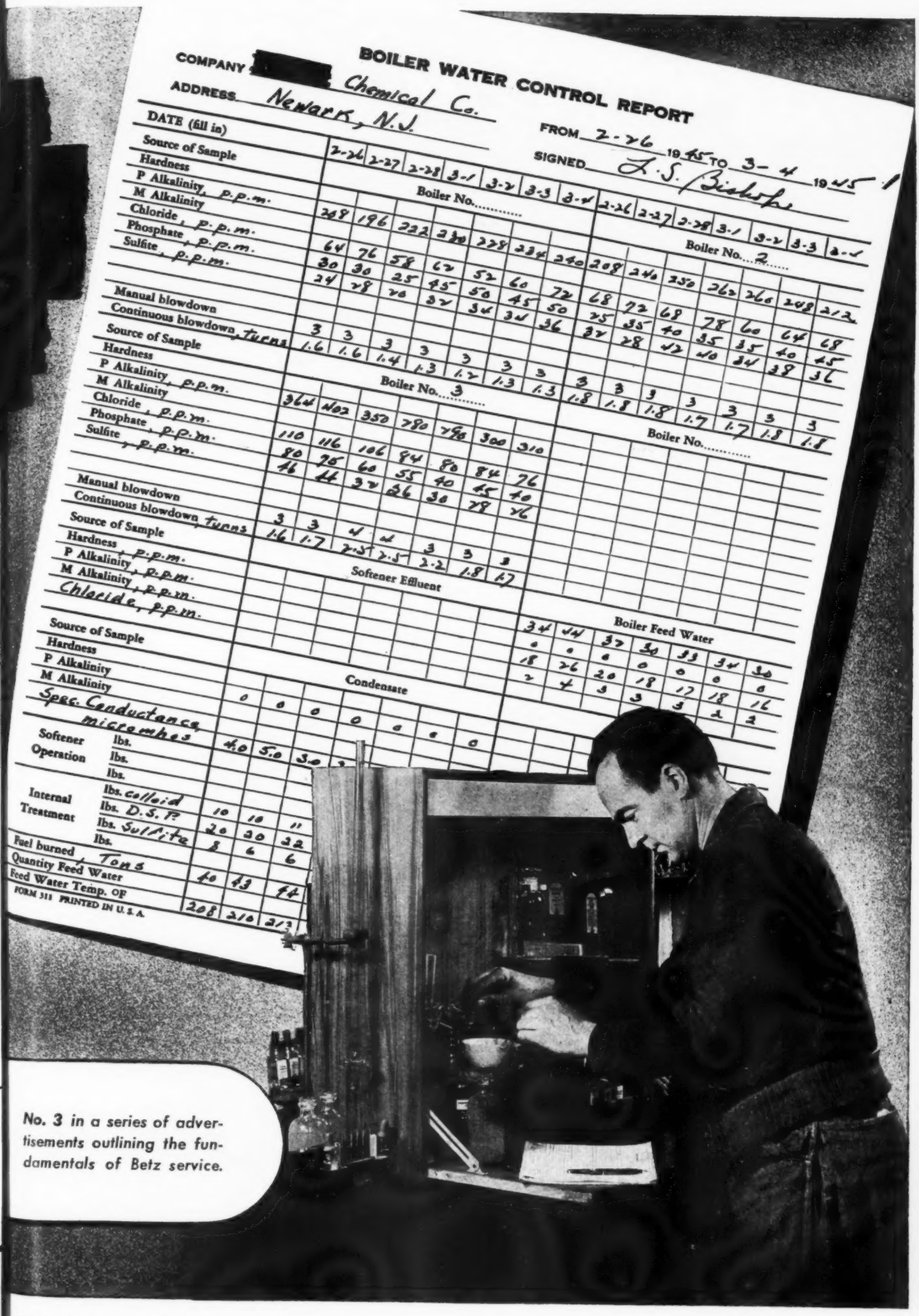
Gillingham & Worth Sts., Philadelphia 24, Pennsylvania

THE 6 FUNDAMENTALS OF BETZ BOILER WATER CONDITIONING SERVICE

1. Complete plant investigation and report.
2. Establishment of plant control.
3. **Daily plant control tests.**
4. Detailed review of plant tests and report.
5. Supplementary complete laboratory analyses.
6. Periodic "check-up" visits.

BETZ

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS



BOILER WATER CONTROL REPORT

COMPANY [redacted] Chemical Co.

ADDRESS Newark, N.J.

FROM 2-26 1945 TO 3-4 1945

SIGNED L. S. Bishop

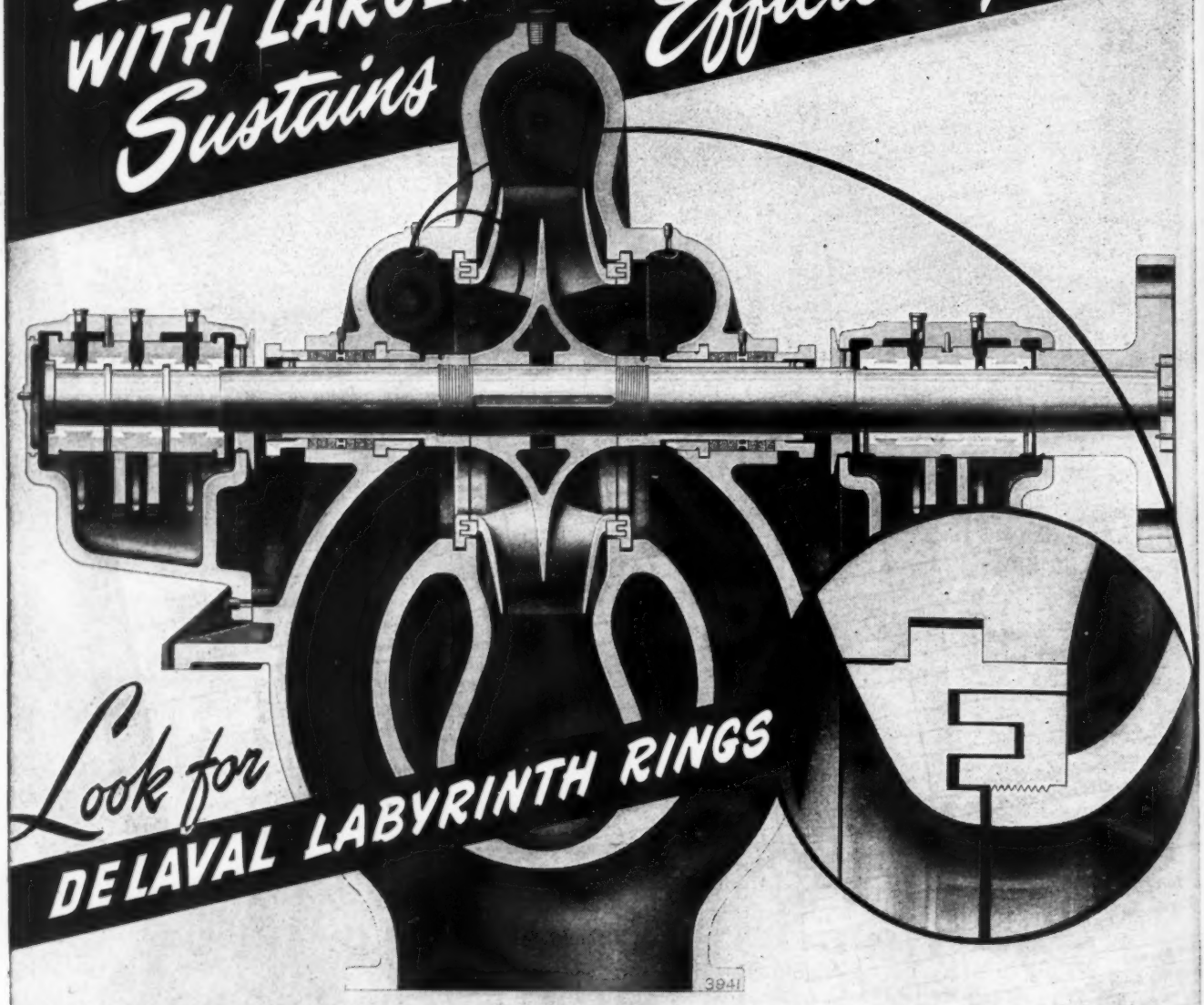
DATE (fill in)	2-26	2-27	2-28	3-1	3-2	3-3	3-4
Source of Sample	Boiler No.						
Hardness							
P Alkalinity, p.p.m.	248	196	222	230	228	234	240
M Alkalinity							
Chloride, p.p.m.	64	76	58	62	52	60	72
Phosphate, p.p.m.	30	30	25	45	50	45	50
Sulfite, p.p.m.	24	28	26	32	34	34	36
Manual blowdown							
Continuous blowdown, turns	3	3	3	3	3	3	3
Source of Sample	1.6	1.6	1.4	1.3	1.2	1.3	1.3
Hardness	Boiler No. 3						
P Alkalinity, p.p.m.							
M Alkalinity	364	402	350	780	796	300	310
Chloride, p.p.m.							
Phosphate, p.p.m.	110	116	106	94	80	84	76
Sulfite, p.p.m.	80	76	60	55	40	45	40
	46	44	32	26	30	28	26
Manual blowdown							
Continuous blowdown, turns	3	3	4	4	3	3	3
Source of Sample	1.6	1.7	2.5	2.5	2.2	1.8	1.7
Hardness, p.p.m.	Softener Effluent						
P Alkalinity, p.p.m.							
M Alkalinity, p.p.m.							
Chloride, p.p.m.							
Source of Sample	Condensate						
Hardness							
P Alkalinity							
M Alkalinity							
Spec. Conductance, micromhos	0	0	0	0	0	0	0
Softener Operation lbs.	4.0	5.0	3.0				
lbs.							
lbs.							
Internal Treatment lbs. colloid							
lbs. D.S.P.	10	10	11				
lbs. Sulfite	20	20	22				
lbs.	3	4	6				
Fuel burned, Tons							
Quantity Feed Water	40	43	44				
Feed Water Temp. °F							
	208	210	213				

FORM 311 PRINTED IN U.S.A.

DATE (fill in)	2-26	2-27	2-28	3-1	3-2	3-3	3-4
Source of Sample	Boiler No. 2						
Hardness							
P Alkalinity, p.p.m.	208	246	250	262	260	248	212
M Alkalinity							
Chloride, p.p.m.	68	72	68	78	60	64	68
Phosphate, p.p.m.	25	35	40	35	35	40	45
Sulfite, p.p.m.	32	28	42	40	34	38	36
Manual blowdown							
Continuous blowdown, turns	3	3	3	3	3	3	3
Source of Sample	1.8	1.8	1.8	1.7	1.7	1.8	1.8
Hardness	Boiler No.						
P Alkalinity, p.p.m.							
M Alkalinity							
Chloride, p.p.m.							
Phosphate, p.p.m.							
Sulfite, p.p.m.							
Manual blowdown							
Continuous blowdown, turns							
Source of Sample							
Hardness, p.p.m.							
P Alkalinity, p.p.m.							
M Alkalinity, p.p.m.							
Chloride, p.p.m.							
Source of Sample	Boiler Feed Water						
Hardness							
P Alkalinity	34	44	32	30	33	34	30
M Alkalinity	0	0	0	0	0	0	0
Spec. Conductance, micromhos	18	26	20	18	17	18	16
Softener Operation lbs.	2	4	3	3	3	2	2
lbs.							
lbs.							
Internal Treatment lbs. colloid							
lbs. D.S.P.							
lbs. Sulfite							
lbs.							
Fuel burned, Tons							
Quantity Feed Water							
Feed Water Temp. °F							

No. 3 in a series of advertisements outlining the fundamentals of Betz service.

LESS LEAKAGE WITH LARGER CLEARANCES Sustains Efficiency



Look for DE LAVAL LABYRINTH RINGS

De Laval Labyrinth Wearing Rings contribute in a large measure to sustaining the high efficiency of De Laval pumps. The large clearance, tortuous labyrinth passage reduces leakage to a minimum and maintains ample running clearances under all conditions.

For sustained efficiency and reduced maintenance costs look for De Laval Labyrinth Wearing Rings when buying centrifugal pumps.

3235

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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POWER

MAY, 1945 VOLUME 89, NUMBER 5

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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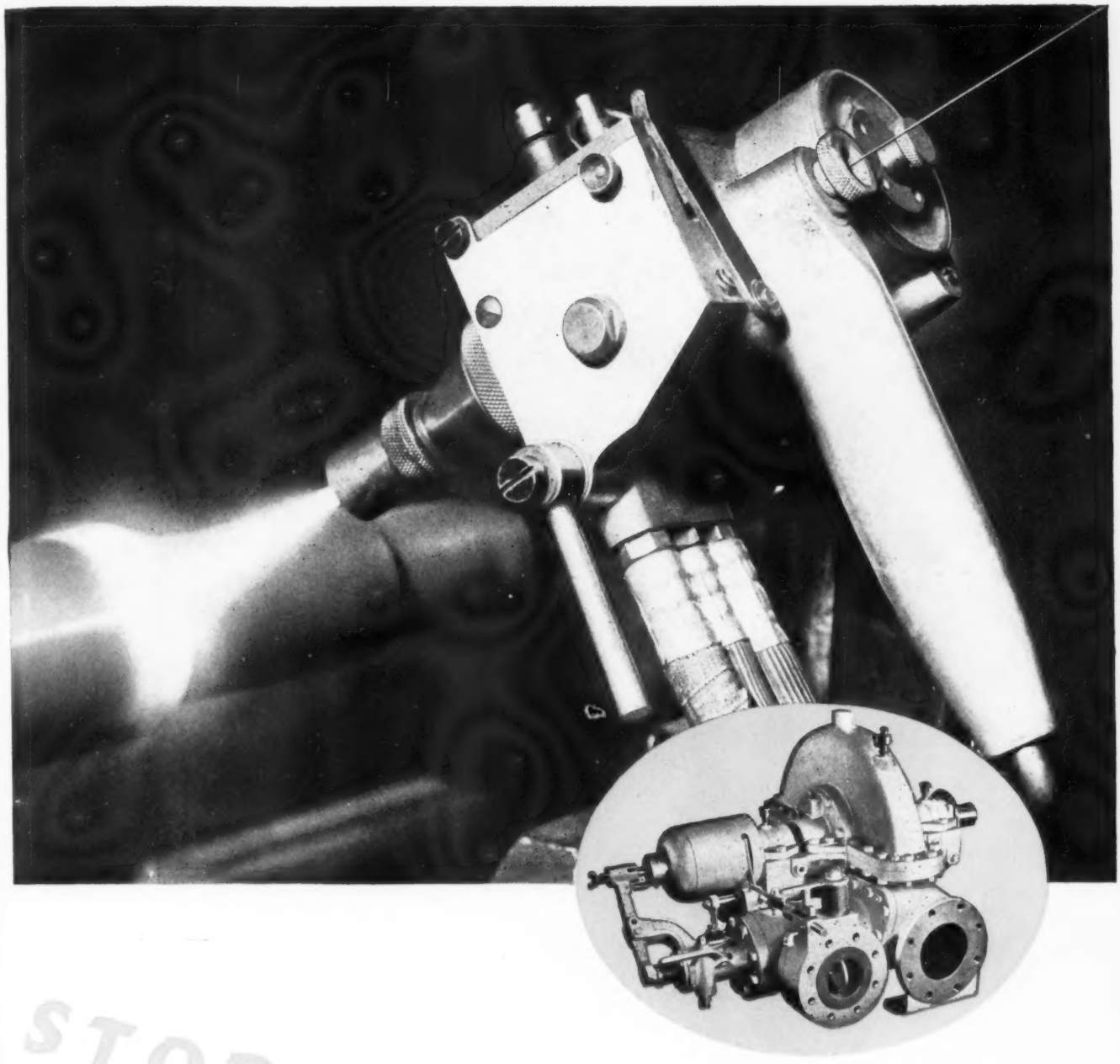

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This Westinghouse shaft-spraying process is an important hidden value of the Type C Turbine. Rust protection prevents excessive steam leakage and oil contamination resulting from rust-cut carbon gland segments.

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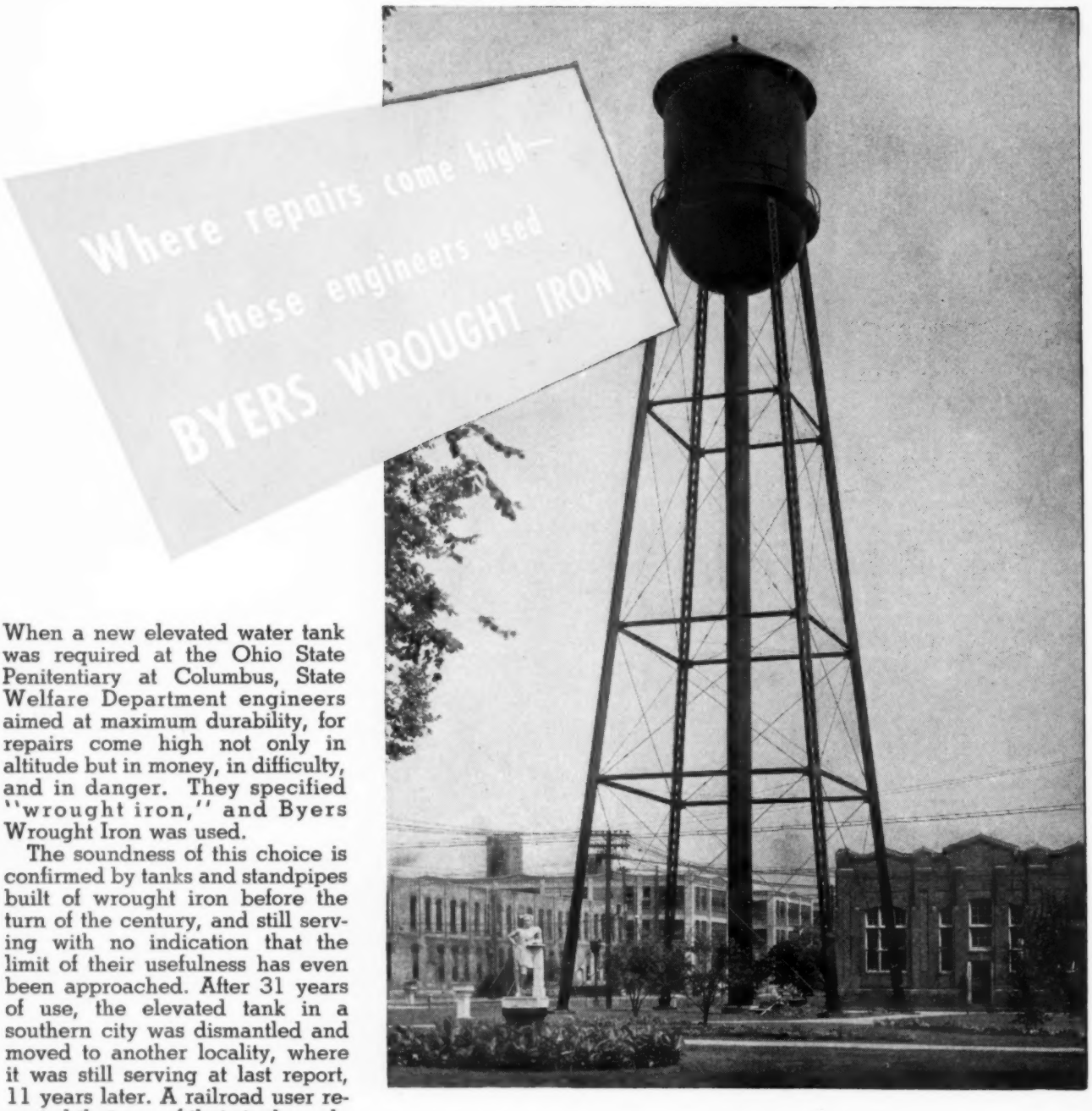

When a new elevated water tank was required at the Ohio State Penitentiary at Columbus, State Welfare Department engineers aimed at maximum durability, for repairs come high not only in altitude but in money, in difficulty, and in danger. They specified "wrought iron," and Byers Wrought Iron was used.

The soundness of this choice is confirmed by tanks and standpipes built of wrought iron before the turn of the century, and still serving with no indication that the limit of their usefulness has even been approached. After 31 years of use, the elevated tank in a southern city was dismantled and moved to another locality, where it was still serving at last report, 11 years later. A railroad user reported that one of their tanks, only 200 feet from the seashore, had lasted 51 years, and was still serviceable. A city in Texas has a standpipe in service since 1885, and at last inspection found only slight corrosion at the top, with the scale tightly adherent and no pitting to be found.

These were selected as typical from among a number of equally impressive examples. Your own experience probably includes others.

The reason for these remarkable records becomes plain when the way in which wrought iron resists corrosion is understood. Wrought iron consists of a body of high-purity iron with a multitude of tiny, glass-like fibers of silicate slag threaded through it. When corrosion strikes, it is halted and diffused by the fibers, thus discouraging the pitting and rapid penetration that cause ordinary materials to fail prematurely. The fibers also serve to anchor the initial protective film, that shields the underlying metal just as a scab protects a wound.

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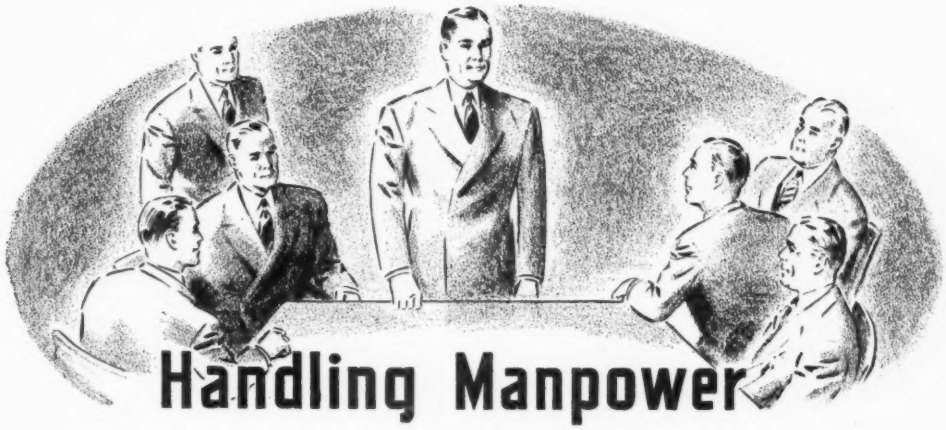


Handling Manpower

AN ENGINEER, they tell us, is a man who "directs the forces of nature in the service of mankind." This brings to mind the picture of some great intellect, trained in the physical sciences and mechanical arts, marshaling kilowatts, fluids and materials to meet human needs.

So far, so good; without trained brains, without a keen understanding of inanimate nature, the works of the engineer would have been impossible. Yet many an engineering master mind leaves little mark on the real world of machines and structures, while others less richly endowed with technical knowledge are known around the world for great accomplishments.

Almost always the difference stems back to lone play versus teamwork. One man lets his brilliant mind operate single handed. He applies to the job only the power within himself. The other adopts the principle of the electrical relay, uses his own moderate talents to set scores, hundreds, sometimes thousands, of other men to work together as an engineering team. In short, he multiplies himself.

Thus the "two-horse" man, working by himself, can do only a two-horse job, so to speak, while the "one-horse" man with the relay gives a thousand-horse performance with less personal effort. No solitary worker can surpass him unless he be a rare genius—a Steinmetz or an Einstein.

The lone star may make his own design, but he can't build the bridge or the power plant. No engineering work of consequence can be finished without the efforts of many men working smoothly together for a common end, or without the services of a leader who can weld the group into a smooth-working team and bend their efforts to the common purpose.

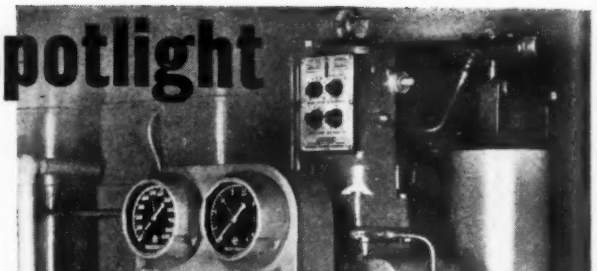
For every big job this rare individual must be found and be given whatever rewards his indispensable service may require. He will be the kingpin in the operation. He will hold the power, the title, the prestige and other important rewards, as long as he can deliver the fruits of cooperative effort. And it will follow as a matter of course that certain "smarter men" will be less favored because they cannot or will not *create* teamwork.

In this connection, one may well question whether the engineer of "unrecognized talent" really deserves much sympathy in this land of opportunity. Where mechanical ability is combined with human ability it need not work long without recognition and reward. And if one lacks those human talents that compel recognition, how can he fairly claim all-round ability in any practical sense?

Learning to lead men is a tough assignment for many well-educated engineers. They find it hard at first to step down from the ivory tower of science, mechanics and logic into the milling human arena—full of workers and loafers, squabblers and soft soapers, fair-weather friends, all-weather friends, hunches, misunderstandings, ambitions, bright boys and dumb clucks, the jelly fish and the stiff necked—plus a lot of just plain, ordinary human beings trying to get along.

This world of people to work with is all around the engineer. He can face up to it or hide comfortably in his technical shell. Which way he turns is a personal matter, but he should be ready to accept the consequences of his choice. If "success" is his aim, he will find no substitutes for leadership and teamwork—ability to handle men as well as machines.

New Developments Spotlight THE GAS-DIESEL



Dual-fuel engines compress gas-air mixture to high level for diesel efficiency; controls permit fuel shift while unit is running under load, or operation on a combination of gas and oil. Here is the history, explanation of working cycle and design details of commercial units

By L N ROWLEY, *Managing Editor*

► Recent announcement of two new dual-fuel or gas-diesel engines featuring high compression of a gas-air mixture again focuses attention on a subject that has interested engineers since Dr Diesel's experiments and patents of the 1890's—the problem of burning gas fuels with diesel-cycle efficiency. In addition, designers have sought ability to shift from one fuel to another instantaneously and to burn two fuels in combination.

Basically, gas can be burned at high compression ratios in two ways:

1. As in diesels burning fuel oil, air *only* is compressed in the cylinder and at or near the end of compression, fuel gas, which has been raised to high pressure in a separate compressor, is injected.

2. As in conventional gas engines, a mixture of air and gas is admitted to the cylinder at about atmospheric pressure. However, the mixture is compressed to diesel ratios of 14-16 to 1 instead of to gas-engine ratios of 4-6 to 1. The compressed mixture is fired by suitable means.

Dr Diesel undoubtedly visualized both methods, at least in broad outline, but his patent claims as quoted in the history below seem to refer most distinctly to the second method. Nevertheless, the belief that pre-ignition would occur if a gas-air mixture were compressed to high levels seems to have barred this line of development until recently and thus the first commercially successful gas-burning diesel worked on the injection principle.

Development of this engine began in 1928 at the Nordberg Mfg Co's shops, with experiments on a 560-hp 2-cycle air-injection engine, using manufactured gas. These tests showed that the gas would ignite and burn in a diesel cylinder without other ignition means but that injection of a small amount of fuel oil stabilized the somewhat irregular ignition met with on gas alone. Injection-air compressor raised fuel gas

HISTORY OF THE GAS-DIESEL

1894-98 Experimental work by Dr Diesel on engines using gas, gasoline and kerosene as fuel led to Patent 109,186, issued in Germany, Jan 27, 1898. This claimed an ignition and combustion process "in which the compression temperature of the working mixture does not reach its own ignition temperature, but the ignition temperature of a second easier-ignited fuel or mixture is reached or surpassed so that an injection of the latter starts the combustion of the mixture."

1901 U. S. Patent 673,160 dated April 30, 1901, granted to Dr Diesel, covered "producing a mixture of air or oxygen and a combustible, compressing the mixture to a temperature lower than the igniting point of the combustible, and introducing under excess of pressure into the mixture a secondary combustible, the igniting point of which is equal to or below the temperature due to the compression . . ." Here were the essential elements of today's engines, including pilot ignition.

1901-26 Diesel's work failed to reach commercial application, probably because of mechanical difficulties and also because improvements in otto-cycle engines made the high-compression gas engine less attractive economically. There were undoubtedly many investigations during this period, but no significant patents.

1926 Diesel's cycle for gas was revived by Humboldt Deutz AG, but again failed to reach commercial proportions.

1927-32 Experiments on high-pressure injection of gas were begun by Cooper-Bessemer Corp and Nordberg Mfg Co. Cooper-Bessemer abandoned work after building and testing a 13x16-in. 2-cycle 300-rpm engine, believing high-pressure-injection design lacked commercial possibilities. Nordberg, after successful shop tests in 1928, converted a 5-cyl 1250-hp 20¾x26-in. 180-rpm 2-cycle air-injection engine at Bisbee, Arizona, plant of Phelps Dodge Corp, during 1931–32.

U. S. Patent 1,858,824 was issued to Victor Heidelberg May 17, 1932, covering "a method of operating a diesel engine, which comprises compressing in the engine cylinder a mixture of air and fuel to a temperature less than its igniting point; igniting said compressed mixture by injecting into it a liquid fuel having an igniting point less than said temperature due to compression; varying the richness of said air and fuel mixture in proportion to the load on said engine, while under all loads maintaining the amount of said liquid fuel injected constant and less than that necessary to operate the engine under no load or idle conditions." A somewhat similar patent (U. S. No. 1,833,265) was issued Nov. 24, 1931, to Kurt Schmidt. These are now held by the Enemy Property Custodian.

1933-36 Nordberg developed hydraulic valve gear for an 8-cyl 1665-hp 17x25-in. 225-rpm 2-cycle engine ordered in June, 1935, by the city of Lubbock, Texas, and installed in 1936. This engine, which is convertible to air-injection fuel-oil burning, represents the first commercial gas-diesel of the injection type. Since this installation, close to 100,000 hp of injection gas-diesels, ranging from 1000 to 3600 hp, have gone into operation and more than 15,000

to 1200 psi for injection through standard air-injection nozzles. Fuel pumps delivered oil during each stroke before needle valve lifted; disconnecting governor from regulating shaft permitted injection of any desired amount of oil. Hand regulation by the starting lever was the sole governing.

Later conversion of an existing 1250-hp 2-cycle air-injection engine gave experience with natural gas, confirming need for *pilot oil* to control ignition. Work on governing schemes showed that varying needle-valve lift was feasible; throttling methods were not. Further governing-system development proved necessary when shop tests on a 1665-hp unit for Lubbock, Texas, indicated that mechanical gear was unsuitable. A hydraulic system was the answer.

Today's engine follows familiar Nordberg 2-cycle design, differing only in the fuel system and provision of a gas compressor, Fig. 1. Fig. 2 shows the hydraulic valve mechanism, with a standard camshaft-driven fuel pump serving as hydraulic power source and injection timer. An open fitting having an inside diameter slightly less than that of the plunger replaces the usual delivery valve. Tubing connects the pump to an actuator cylinder; the actuator plunger lifts the fuel valve through a lever. The gas injection valve resembles an air-injection unit, without atomizer plates and other internal parts not needed when oil injection is limited to pilot quantities of about 5%.

Multiple fuel-injection pumps formerly supplied pilot oil, but recent experience indicates that small individual pumps prove better because they permit convenient adjustment of pilot oil to individual cylinders. These pumps connect to the regulating shaft through a linkage which cuts off pilot-oil supply during starting and stopping. Pilot-oil amount remains constant over the full load range.

No installation has yet required instantaneous convertibility. As built, engines convert readily from gas operation to either air- or solid-injection operation. Throttling compressor suction by a regulating valve, which maintains constant gas pressure at injection valves, accomplishes regulation.

Test performance of the Lubbock engine, based on high heating value, is as follows:

Load	100%	75%	50%
Gas, Btu/kwhr	11,260	10,228	10,885
Pilot oil, Btu/kwhr	650	900	1,400
Total, Btu/kwhr	11,910	11,128	12,285

For a 20-month period, heat rate averaged 11,427 Btu per kwhr. A one-year record at the Indian Irrigation Service plant, Coolidge, Arizona, showed 11,579 Btu per kwhr. Both long-term figures include pilot oil and are based on high heating value. The low or effective heating value of natural gases is about 10% less than the high value.

It was while experimenting with high-pressure gas engines working on this injection principle that the idea of

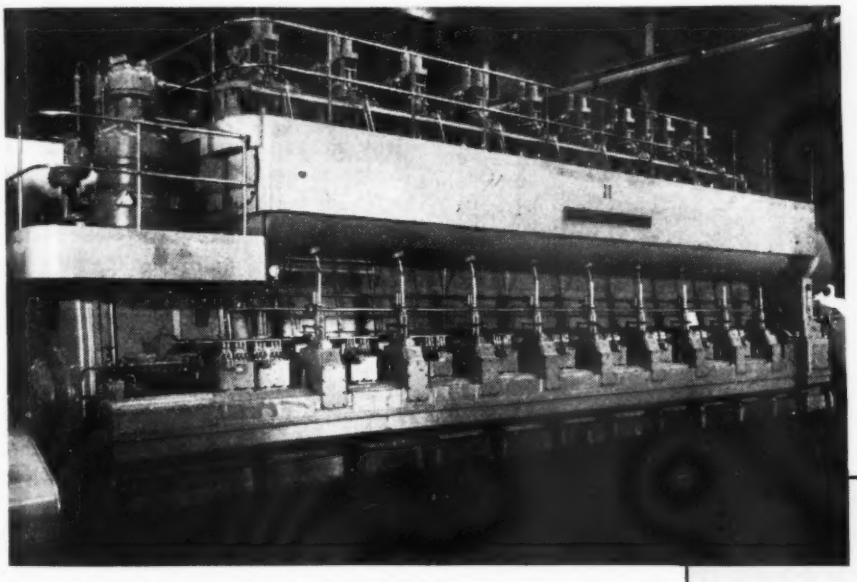


Fig. 1—Nordberg gas-burning diesel showing gas compressor and pilot-oil pumps at left and actuator pumps along engine camshaft

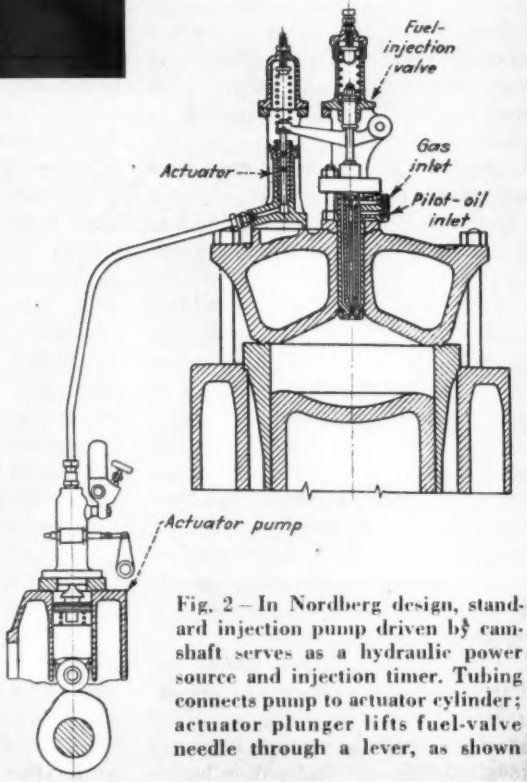


Fig. 2—In Nordberg design, standard injection pump driven by camshaft serves as a hydraulic power source and injection timer. Tubing connects pump to actuator cylinder; actuator plunger lifts fuel-valve needle through a lever, as shown

hp of air-injection engines now burning fuel oil have been arranged for conversion to gas burning.

1937-40 Experiments in England in 1938 with high-compression gas engines of the injection type, particularly the Erren engine, led to trials of an engine in which fuel gas was introduced with intake air, at about atmospheric pressure, compressed to diesel levels and ignited by injection of a small quantity of fuel oil. National Gas and Oil Engine Co, the builders, also experimented with spark ignition. This was followed by commercial introduction of five engine series, four with pilot-oil ignition and one with spark. Gas-diesel or dual-fuel engines of this type were also developed by Harland & Wolff and Blackstone-Brush.

1941-43 In the United States, Cooper-Bessemer Corp and Worthington Pump & Machinery Corp began development of engines similar to British types, featuring high-compression of the gas-air mixture and capable of shifting fuels while operating.

Facing wartime fuel-oil shortages, the German Economic Board sponsored investigation of the conversion of oil-burning diesels to gas and a program for changeover of existing units. Also because of oil shortage, a number of diesels in South America were converted to operate on producer gas at high compression.

1944-45 In Aug and again in Nov, 1944, a dual-fuel engine was announced and demonstrated to a group of engineers by Worthington. Early in 1945, Cooper-Bessemer released for publication announcement of the commercial availability of their gas-diesel. Both later announced development of systems for supercharging such engines.

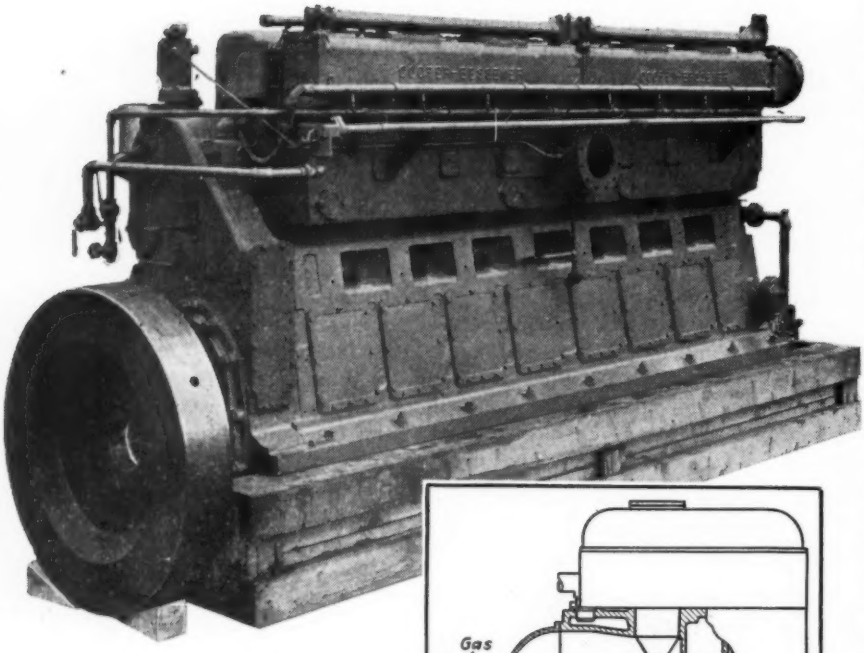


Fig. 3—Shop view of engine ready for shipment shows gas manifold and regulating valve with its governor control rod

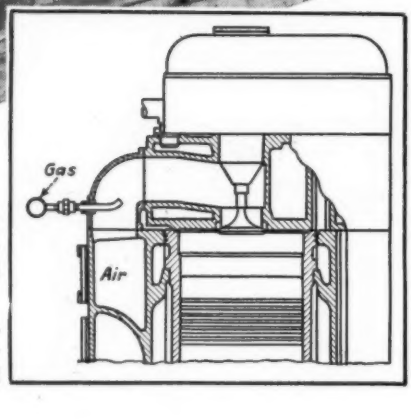


Fig. 4—Diagram indicates method of introducing gas from manifold into elbow connecting air manifold to cylinder head

trying the *mixture* principle occurred to engineers of National Gas and Oil Engine Co, of Great Britain. The engine proved successful and led to the first commercial development of this type. This unit and most of the designs developed since operate as follows: a mixture of gas and air is admitted at about atmospheric pressure, compressed to 400-500 psi and ignited by injection of pilot oil.

Engineers familiar with gas-engine practice know that compression pressure for any particular gas is definitely limited and when it is exceeded the gas-air mixture ignites before it is fired by the spark. This pre-ignition condition was so well known, in fact, that most engineers simply considered it impossible to compress a gas-air mixture to diesel levels. When actual test proved it could be done, it became evident that a number of significant differences between gas and diesel engines had been overlooked. To understand why pre-ignition is not a problem, let's review briefly some basic facts about gas-air mixtures and the way fuels burn in otto- and diesel-cycle engines.

If a gas mixes with just enough air to burn the fuel constituents of the gas completely, it is said to be a *perfect* mixture. If such a mixture is heated gradually, chemical combination begins slowly but eventually a temperature is reached at which practically instantaneous combustion occurs and *will continue without further application of heat from any outside source*. This is the *ignition temperature*. At this point, chemical combination generates heat faster than it is lost to the surroundings and combustion is self-propelling.

The same thing is true of mixtures a little richer or leaner than a perfect mixture. However, there is a limit on either side of the perfect mixture beyond which it becomes either too rich or too lean to ignite and continue to burn *without application of external heat*. These are the *limits of inflammability* and mixtures within this range are called *inflammable* or *explosive* mixtures. Both ignition temperature and limits of inflammability are affected by pressure; values commonly given in handbooks are for atmospheric pressure. In general, gas-air mixtures at high pressure ignite at lower temperatures. Influence of pressure on limits of inflammability is not well known; experiments with different gases show some contradictory results.

To bring the question of gas-air mixtures down to earth, consider a common gas, methane. Major constituent of natural and sewage gas, methane shows an ignition temperature in air of 1202-1382 F. Lower and upper limits of inflammability, percent by volume in air, are respectively, 5.8 and 13.3. Ignition temperature and limits of inflammability for commercial gases vary with composition and little data is available. However, a number of natural gases show a lower limit of inflammability ranging from 4.6 to 5.2% and upper limit from 13.9 to 14.9%.

Gas-Engine Combustion

To put these facts about gas-air mixtures to work, let's see how fuel burns in a conventional gas engine. The mixing valve proportions gas and air to form a mixture not far from perfect, which is then compressed. This raises mixture temperature and lowers ignition point. Combustion starts at a single point, initiated by some external heat source such as a spark plug. Heat developed by this local burning raises mixture temperature to ignition point and mixture burns almost instantly.

Such an engine can operate only with mixtures that lie in the inflammable range and are thus able to burn after instantaneous localized ignition, as by a spark. In turn, operation with little excess air is possible because fuel and air mix intimately before compression. It can be seen then, that sensitivity of gas engines to pre-ignition results from the fact that mixtures are always in the inflammable range and that localized hot spots, such as the spark plug, are present to start burning.

In a typical diesel, the situation differs. Fuel is injected into air heated above ignition point of fuel by high compression. Fuel particles burn with oxygen from the immediate surrounding air. Fuel and oxygen must combine inside the cylinder, in an extremely short time. Hence the effort to make injection systems break the fuel into smallest possible particles and disperse them throughout the air space and to design combustion chambers to impart motion and turbulence to the air. Of necessity, diesels operate with high excess air. Because diesels are governed by regulating fuel quantity, with air constant, excess air runs even higher at partial loads.

Diesel Mixture Is Lean

In contrast then to the gas engine, which operates on an approximately perfect mixture, the diesel operates with an extremely lean mixture. High excess air characteristic of diesel combustion proves the key to ability to burn gas-air mixtures at high compression ratios without pre-ignition. Let's see what happens if we switch from

oil to gas on a diesel and admit gas and air together, before compression.

For simplicity, assume that the fuel is natural gas, which has about the same heating value as fuel oil or a little better. It can then be seen that in any particular diesel, weight of gas to be burned to carry full load would run about the same as weight of fuel oil and thus fuel-air ratio would remain about the same. This means an extremely lean mixture, close to the lower limit of inflammability.

Mixture having been admitted to the cylinder, compression raises temperature to approximately 1000 F, which is probably above the ignition temperature, which is low at that high pressure. However, the mixture cannot ignite because it is just outside the inflammable range. Pilot oil is injected and when it hits this mixture, the oil begins to burn, just as it would if injected into heated air. The heat added by the pilot oil's burning initiates, sustains and propagates combustion.

Therein lies the important difference between spark and pilot-oil ignition. The spark is intensely hot, but highly localized and short lived. It serves to start burning in an inflammable mixture but does not add heat progressively as needed to sustain combustion in an extremely lean mixture. On the other hand, pilot oil disperses throughout the mixture and, while the injection period is short measured in time, it is long relative to the entire combustion period. Amount of heat added is substantial, 5 to 10% of the total. Experiments on running engines indicate that no matter how little gas is present in the mixture the pilot oil insures burning.

Experience to date indicates that at full load the mixture runs close to the lower limit of inflammability. On one engine, for example, gas percentage reaches 4.5% at 85 bmep, which is the unsupercharged rating. Higher bmep has been carried and it seems that, in general, a given engine operating on gas or gas and oil can carry somewhat higher bmep than on oil alone. It is possible that at high bmep's the gas-air mixture edges into the inflammable range; if so, failure to pre-ignite must be laid to the generally poor ignition qualities of mixtures at the low end of the range.

One might ask "How about gases which, unlike natural gas, have a lower heating value than oil?" Experience with such engines in this country is confined thus far to natural gas, mixed natural and city gas, city gas and sewage gas. Results indicate the rating for fuel oil applies equally to these gases. British and German experience indicates that for producer gas, which is extremely lean, a given engine must be derated. More definite answers wait on research and operating experience.

So much for the operating principle of the diesel handling gas-air mixtures, as it is now understood. How do such engines differ in construction from conventional diesels? Obviously, a number of arrangements can be devised for introducing the gas-air mixture into the cylinder, for injecting pilot oil and for controlling operation. These can be examined best by looking at engines now offered commercially by Cooper-Bessemer and Worthington, with occasional references to other arrangements, some of which are understood to be in development by other companies, notably Chicago Pneumatic Tool Co and Rathbun-Jones Engineering Co.

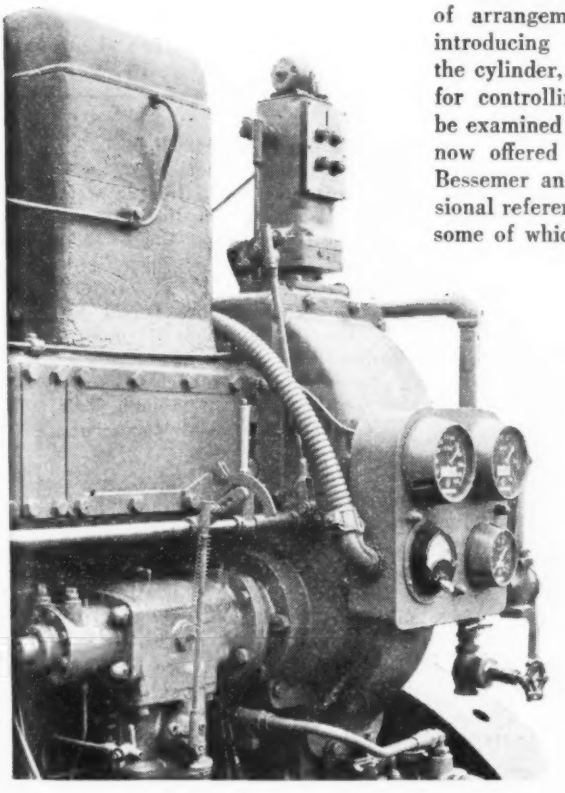


Fig. 5—Standard Cooper-Bessemer control operates as follows: With engine running on all oil, operator opens gas shutoff, lever-operated valve at extreme right. Governor assumes control of gas flow, dividing load between oil and gas. Operator then shifts fuel-pump lever to pilot-oil position, taking pump off governor control, which then regulates gas supply and the fuel shift is complete. An automatic stop shuts down engine if load exceeds 110% on gas

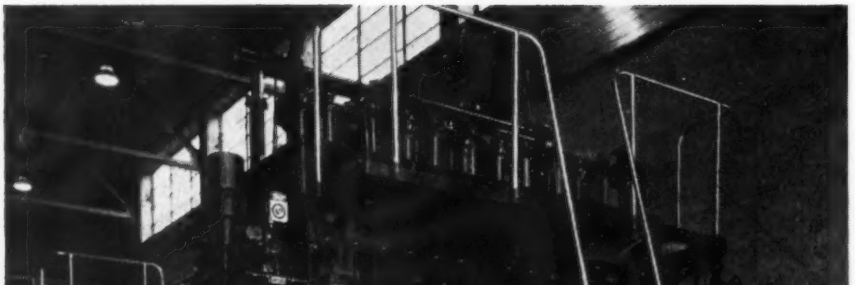
Cooper-Bessemer began experimental work on the idea of mixing gas and air before compression in 1941-42, after having built an injection-type gas-diesel (see history, p 64). In working toward a commercial design, their engineers concentrated on achieving simplicity, particularly to facilitate conversion of existing engines. Units show a heat rate of 7500 Btu per bhphr, including both gas and oil, based on lower heating value.

Gas-Air Supply System

For the gas-air supply system, consideration was given to using a conventional mixing valve at the air manifold entrance. With the air butterfly open the gas butterfly would regulate. The mixture would flow to the cylinders through the normal intake system. For better distribution among individual cylinders, Cooper-Bessemer adopted a separate gas manifold, with connections to individual cylinders at the elbow leading from air manifold to cylinder head, Fig. 3 and 4. Gas enters the air stream and mixing occurs ahead of the inlet valve. After considering relative merits of a single gas regulating valve or individual valves for each cylinder, Cooper-Bessemer chose the single valve, using a standard unit. This system can operate at gas pressures of a few inches of water, but preference is for 2 to 5 psi.

Decision to use the regular injection system rather than install a separate system for pilot oil achieves simplicity believed to offset the fact that pilot-oil percentage should be held to 10% or more to insure reliable injection with nozzles and pumps designed to carry full load on oil. If it is desired to operate for relatively long periods on gas, without instantaneous convertibility, Cooper-Bessemer will supply auxiliary fuel tips to permit operation with less than 10% pilot oil where fuel-oil saving is important. They do not believe in furnishing both at one time, however.

For the gas-diesel, a large number of control arrangements are possible. Simplest of all would be to shut down the engine while running on oil, cut the fuel injection to the desired minimum and shift the governor control rod from the fuel pump to the gas regulating valve. However, considerably greater convenience can be had without markedly increased complication by installing two control rods, as shown in Fig. 5 and explained in the caption. This arrangement, which permits changing fuels while engine is running under



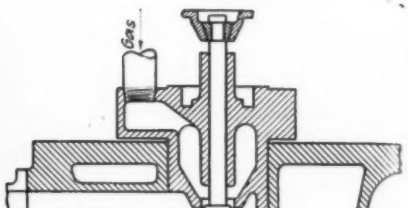


Fig. 7, above—Diagram shows Worthington's method of introducing gas into the cylinder, using a piston on valve stem

Fig. 6, left—This 16x20-in. 4-cyl gas engine at Tallmans Island sewage disposal plant, originally rated at 327 rpm and 460 hp, has been converted to operate on the more efficient high-compression cycle

load, is offered as the standard control.

In addition, a number of other control arrangements are available where application conditions justify. Functions of the standard control can be combined so that fuel shift is a single operation. Photo at top of p 64 shows the single handwheel, which starts and stops the engine and shifts from one fuel to the other. An automatic stop, limits load on gas to 110%; load above this point is carried by oil. On a combination of oil and gas, engines have successfully carried 120 bmep, nearly 50% overload.

Both preceding controls provide essentially for shifting from all oil to gas plus pilot oil; period of operation on both fuels during the change is purely temporary. For applications where operation on a combination of fuels is desirable, Cooper-Bessemer offers a control to carry load up to limit of available gas supply, automatically supplemented with fuel oil as required.

Cooper-Bessemer now builds gas-diesels in regular production. One installation has been made and another is under way.

Worthington Pump & Machinery Corp began experimental work on an engine to compress a gas-air mixture to diesel levels in 1942. Early in 1944 a 500-hp diesel was equipped to operate on *either* gas with pilot oil or oil alone. Fuel changeover was accomplished with ease at full load, without interrupting operation or affecting load. This engine was demonstrated in August. However, an appraisal of the field seemed to indicate need for a unit capable of simultaneous operation on gas and oil in varying proportions. On Nov 17, 1944, the engine was again demonstrated, and operated through a range of from 95% gas and 5% pilot oil to 100% fuel oil with any desired proportion between these extremes. It is this engine that Worthington now offers as its standard unit.

To add field experience to shop tests, Worthington started early this year to convert an engine at Tallmans Island sewage-disposal plant, New York, from the low-compression spark-ignition type to a diesel or high-compression pilot-oil-ignition unit. The fact that this engine was essentially a duplicate of the shop unit, as to bore, stroke and number of cylinders, facilitated conversion and added value to field observations. Like all Worthington gas engines, it is designed structurally for diesel stresses so that higher pressures presented no problem. The shop engine operated on mixed natural and city gas;

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the Tallmans Island unit runs normally on sewage gas of 640 Btu per cu ft, with city gas of 537 Btu as standby fuel. Fig. 6 and the cover photo show the Tallmans Island engine.

The Worthington design emphasizes maximum performance. Gas-supply system consists of a manifold connecting to individual regulating valves, one for each cylinder. Each valve links to a common control rod with provision for adjustment to balance gas flow to individual cylinders (see cover photo). Gas from the regulating valve is piped to the cylinder head where a special valve construction permits control of gas-admission timing, Fig. 7. A piston on the valve stem opens and closes the gas port, which is above the air port. Gas-supply pressure can be as low as 2 in. of water.

To permit cutting pilot-oil requirements to a minimum (5%) Worthington uses a separate injection system, sized to handle small flows. The pilot-oil system comprises a multi-cylinder jerk pump, mounted at the control end, and individual watercooled nozzles. Main fuel nozzles are also watercooled. Pilot-oil nozzles do not operate when engine runs on oil fuel. Pilot-oil flow is adjustable but after best setting for a given application is reached it is not normally changed.

The standard control system for the Worthington engine provides for operation on gas plus pilot oil, all oil, or any desired proportion of the two fuels. It also permits burning all available gas, automatically supplemented with enough fuel oil to carry the load. The single handwheel that controls starting, stopping, and fuel-proportion adjustment is shown in Fig. 8. It operates a control rod running the length of the engine which adjusts the fulcrum point of the linkage connecting the governor to the gas-supply control rod and the fuel-oil rod. Moving the fulcrum point changes the effective motion of the two control rods and thus divides load between the two fuels in the desired proportion. Fig. 9 shows the governor linkage. The handwheel is graduated to show proportions of gas and oil.

As in the case of conventional diesel engines, supercharging offers the advantages of greater output for a given cylinder displacement and somewhat improved fuel consumption. Curves in Fig. 10 and 11 show performance of a Worthington dual-fuel engine, operating on gas plus pilot oil and on all oil, both supercharged and unsupercharged. Typical performance of a spark-ignition gas engine is included for comparison. It is interesting to note that the curve for the dual-fuel engine operating on gas plus pilot oil follows the general shape of the spark-ignition-engine curve, rather than the typical oil-burning diesel curve. The reason for this is not yet clear.

The unsupercharged engine is rated at 80 bmep and the supercharged unit at 112.5, which represents a gain in output of about 40%. Best heat consumption for the supercharged engine on gas plus pilot oil is 6500 Btu per bhphr, compared to 7000 for the unsupercharged unit. Indications are that considerably higher bmep's than those shown can be obtained with supercharging.

In pressure-charging the dual-fuel engine, some differences from conventional practice appear. For proper control, gas pressure must be maintained in correct relation to air pressure. Where gas is available under pressure,

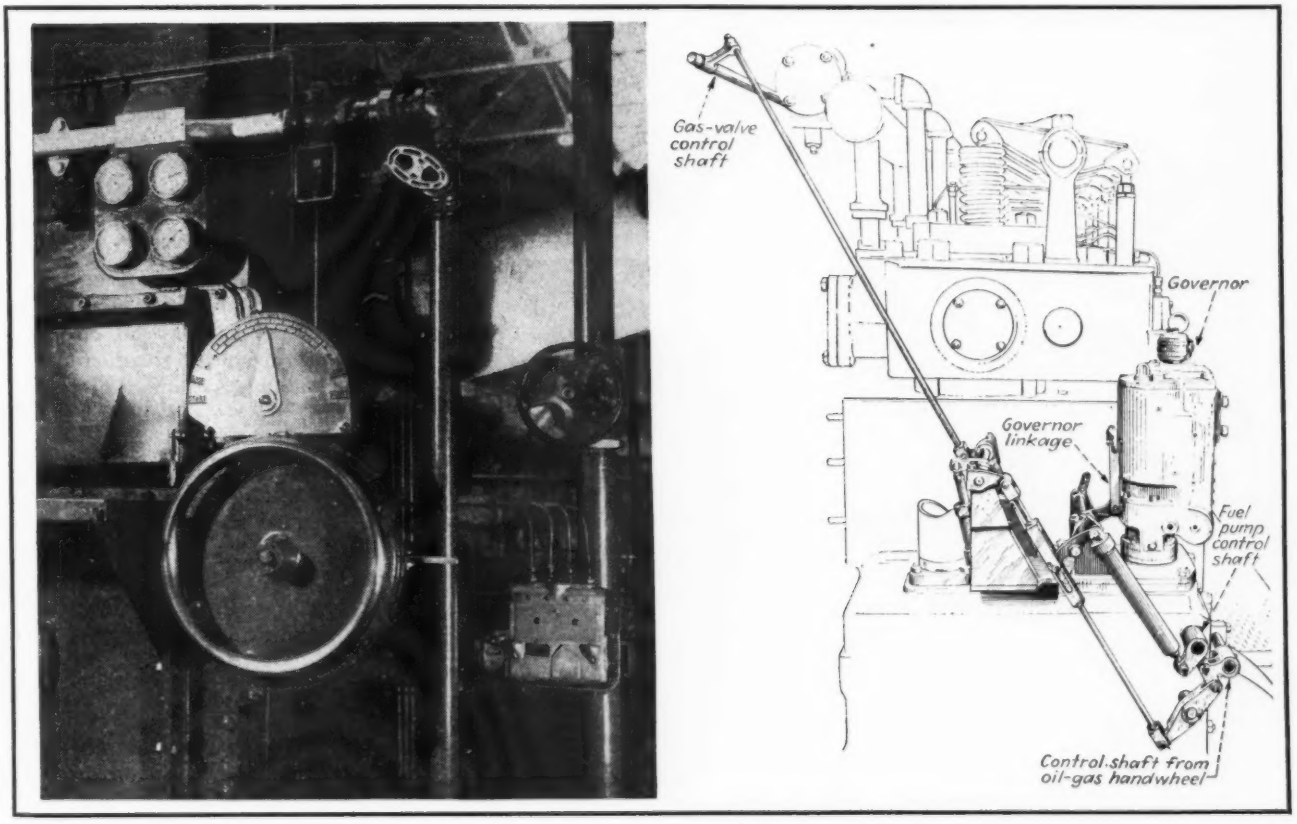
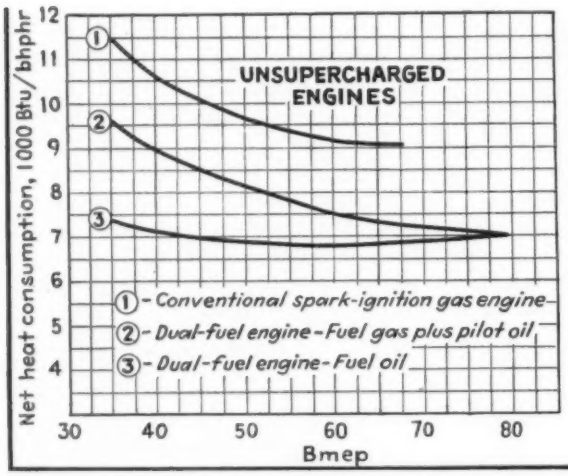


Fig. 8—Control end of test engine at Worthington shops, showing handwheel for starting, stopping and controlling relative proportions of gas and oil fuel. Handwheel actuates a shaft running the length of the engine to tie-in with the governor mechanism shown in Fig. 9. Note multi-cylinder injection pump for pilot oil. Fig. 9—Motion of control shaft, actuated by handwheel, moves levers to change position of fulcrum point at which governor lever connects to rods actuating common control shaft for fuel pumps, lower right, and gas-regulating valves, upper left. This shift in fulcrum point changes effective motion of control rods, varying relative proportions of gas and oil fuel according to handwheel setting


UNSUPERCHARGED ENGINES
Net heat consumption, 1000 Btu/bhphr
Bmep
1 - Conventional spark-ignition gas engine
2 - Dual-fuel engine - Fuel gas plus pilot oil
3 - Dual-fuel engine - Fuel oil

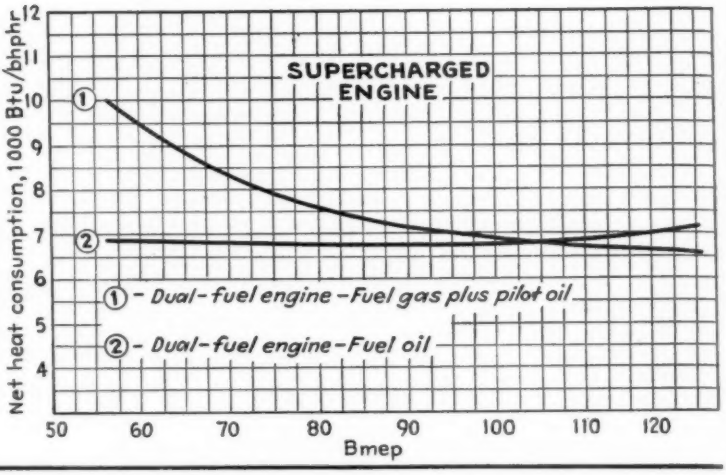

SUPERCHARGED ENGINE
Net heat consumption, 1000 Btu/bhphr
Bmep
1 - Dual-fuel engine - Fuel gas plus pilot oil
2 - Dual-fuel engine - Fuel oil

Fig. 10, left, and Fig. 11, right—Performance of unsupercharged and supercharged Worthington dual-fuel engines, on gas plus pilot oil and on all oil, with curve for typical spark-ignition gas engine indicated for ready comparison

this becomes merely a matter of regulation, but where gas pressure is inadequate, the gas must be supercharged as well as the air. Means for timing gas admission are indicated in connection with provision of the valve overlap involved in the Buechi system. It is hoped that it will be possible to discuss the design details of various supercharging systems in later articles.

Engine Applications

Ability to operate on either gas or oil fuels, or both, to shift easily from one fuel to the other, and to obtain efficiency on gas as about high as that of the conventional diesel burning oil point to a wide range of applications for gas-diesel or dual-fuel engines.

For example, most sewage-disposal plants require more power than can be generated from available sewage gas. This may be obtained by purchasing electricity, by supplementing sewage gas with natural or manufactured gas, or by generating some power with diesel engines. The higher efficiency of the gas-diesel permits generating about 20 to 25% more power from the available sewage gas and supplementary power can be generated in the same engines by using fuel oil. To these advantages must be added the flexibility of control that makes it easy to adjust engine operation for variations in gas supply.

In oil-field operations, low-cost natural gas is often available after flow is established but oil fuel is commonly used during drilling. A dual-fuel engine can utilize whichever fuel is most economical at any given time. Similar situations often exist along pipelines, where either natural gas or oil fuel may be available at low cost.

In refineries, byproduct gases form an economical fuel supply but there are times when gas supply is inadequate for the engine capacity that would normally be installed. The gas-diesel not only burns the available gas more efficiently but makes it easy to supplement gas supply with fuel oil as needed. Absence of electrical ignition eliminates fire hazard.

There are many areas where attractive gas rates may be had if the customer agrees to use gas only during the off-peak summer months or to permit the gas utility to interrupt service on short notice. Facility in shifting from gas to oil operation makes the dual-fuel engine attractive in such situations. The same reasoning also applies in areas where gas and oil are competitive and the price situation fluctuates so that it is sometimes more economical to burn gas and other times oil. Here, however, the user must compare the gain from ability to shift fuels quickly with the fact that the dual-fuel engine must be expected to run somewhat higher in first cost than a convertible engine, which requires time for changeover and gives only conventional gas-engine efficiency on gas fuels.

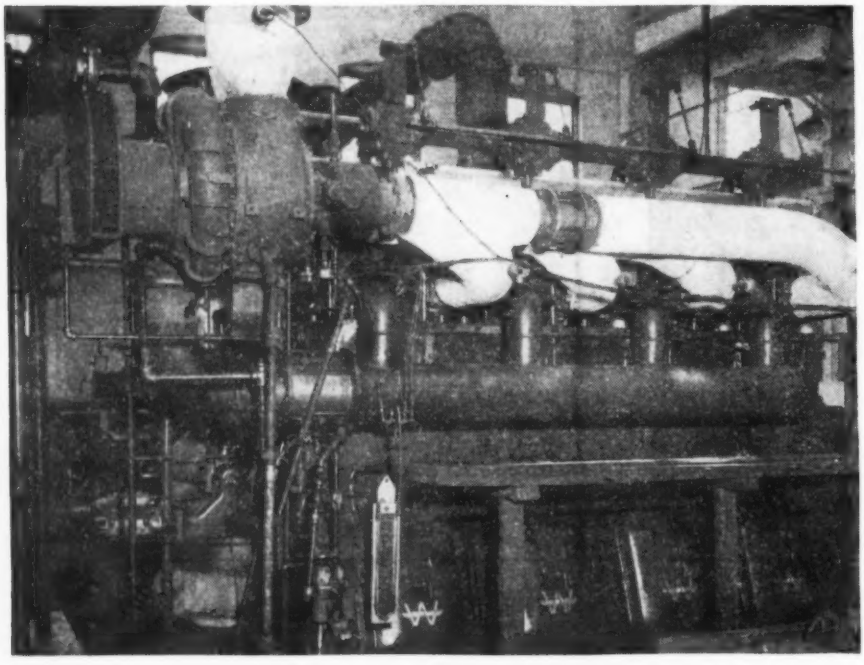


Fig. 12—Test engine at Worthington shops equipped with Elliott-Buechi turbocharger. The results of Fig. 11 were obtained with this supercharged engine

Acknowledgments

The author is indebted to Robert Cramer Jr, asst chief engr, Nordberg Mfg Co, for permission to abstract from his paper "Progress in Gas-Burning Diesel Engines and Plants", and to R L Boyer, chief engr, Cooper-Bessemer Corp, J C Barnaby, consulting engr and A M Boehm, sales engr, Worthington Pump & Machinery Corp, for data and helpful comments on the article.

Simplified Semi-Outdoor Design for Modern Generating Stations

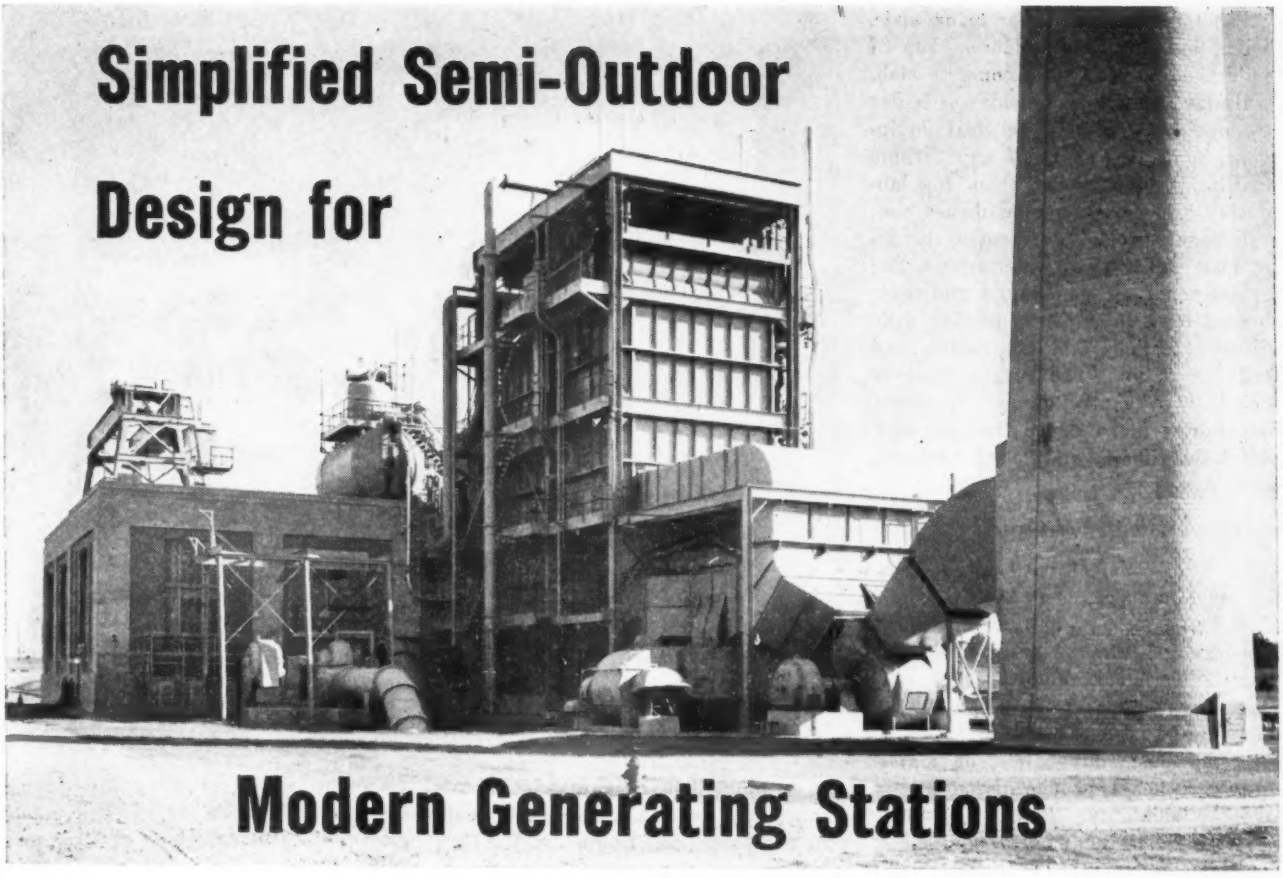


Fig. 1 — Rear view of 350,000-lb-per-hr 710-psi 830-F boiler, pump and fans at 30,000-kw Harvey Couch station, Arkansas

Recent designs employing centralized operating controls, streamlined boiler-turbine units and minimum building dimensions have accomplished savings in investment, operating and maintenance costs of steam-electric power stations

By H L LOWE and T C HOYT
Ebasco Services Incorporated

▶A VARIETY of semi-outdoor power plants have been constructed during the past decade, among which are several designs that provide minimum housing for major equipment. The same period has seen a trend toward centralization of operating controls and unit boiler-turbine installations that avoid duplication of steam headers and auxiliary equipment. These improvements have meant substantial savings in capital investment and in operating and maintenance costs. While experience has been mostly in installations from 20,000 to 40,000 kw, the same principles can be applied to plants of practically any size.

Semi-outdoor design imposes no restrictions on future development of single-unit plants to large stations and is adaptable to extension of existing plants of conventional design. Although extremely severe conditions may justify some special modifications, experience demonstrates that semi-outdoor plants can operate in practically any climate. General Electric, for instance, has operated its well-known mercury installation outdoors for eleven years at Schenectady, N. Y., where winter temperatures range down to —30 F, with heavy snows and high winds.

Several Installations

Orem station, near Provo, Utah, and an installation in Omaha, Neb., are subjected to severe cold and snow. Outdoor features of other plants in the Southwest have proved satisfactory even during high summer temperatures and rainstorms of great intensity.

In future construction, designers will give careful attention to any practical means of saving labor and material. Estimated savings for a recent semi-outdoor single-unit 25,000-kw installation, in comparison with conventional fully housed design, amount to about 75% in building volume and 50% in inclosed floor area, 75% in structural steel and 50% in structural and reinforcing steel combined.

Economies naturally vary with degree of simplification. A saving of at least $5 per kw can be made by reducing equipment housing alone. Savings of over 25% have been realized by simple unit-type semi-outdoor designs as compared with more elaborate fully housed plants. It is reasonable to conclude that further justifiable economies will be obtained in the future.

Fig. 3 illustrates the sectional outline of inclosure provided for a 30,000-kw gas-fired installation, with a dashed line to show corresponding conventional housing. The inclosure for the semi-outdoor design contains about one third the volume of the more usual type of building.

Except for operating or firing aisle, boiler and fans are outdoors. Top of boiler is protected by a concrete slab. Walkways and stairs at sides of boiler are open. Auxiliary electrical equipment, some of the boiler and turbine auxiliaries, office, locker room and laboratory are housed. A penthouse control room is located adjacent to the firing aisle and level with the turbine. The turbine-generator stands on a roof deck covered by a light metal housing with all roof sections and the exciter end wall removable. The turbine unit is served by a gantry crane. A single forced-draft fan, induced-draft fan and circulating pump, all placed outdoors, serve the plant.

Electrical Gear

As usual in conventional designs, the semi-outdoor plant has its main power transformers and all auxiliary transformers outdoors and apart from the building. All except auxiliary switchgear is of outdoor type supported on relatively inexpensive mountings.

In the past, duplication of major equipment has been considered necessary for reliability. Because of their improved reliability, modern equipment and transmission interconnections have combined to make "unitized" stations practical. Simplification of plant to a reasonable degree may be effected by balancing certain items for operating convenience and over-all reliability against lowered cost.

In unit-type design, it is customary to duplicate auxiliary equipment that would cause station shutdown or severe damage to major plant equipment if failure occurred. In a moderate-sized plant this certainly includes the boiler-feed pump and some conditions justify two circulating-water pumps. Duplication of other items, such as condensate pumps, can be accomplished at small cost and hence may be justifiable to insure against plant shutdown from a failure of minor equipment. In plants of 35,000 kw and larger, at little additional cost, draft fan capacity may be divided into two parts for convenience as well as improved reliability. As reliability of individual equipment is gradually bettered, further simplification of power units may be possible. The trend is now definitely away from duplication but it is yet impossible to predict just how far this trend will go.

As an example of semi-outdoor construction, the 30,000-kw Harvey Couch station of the Arkansas Power & Light Company combines simplified layout with minimum housing. The plant, added to meet war loads, feeds into a 110-kv transmission network supplied by both hydro and steam plants as well as some purchased energy. No direct-condensing water is available, necessitating a cooling tower. Gas fuel is available from a nearby "sour-gas" field, at low cost.

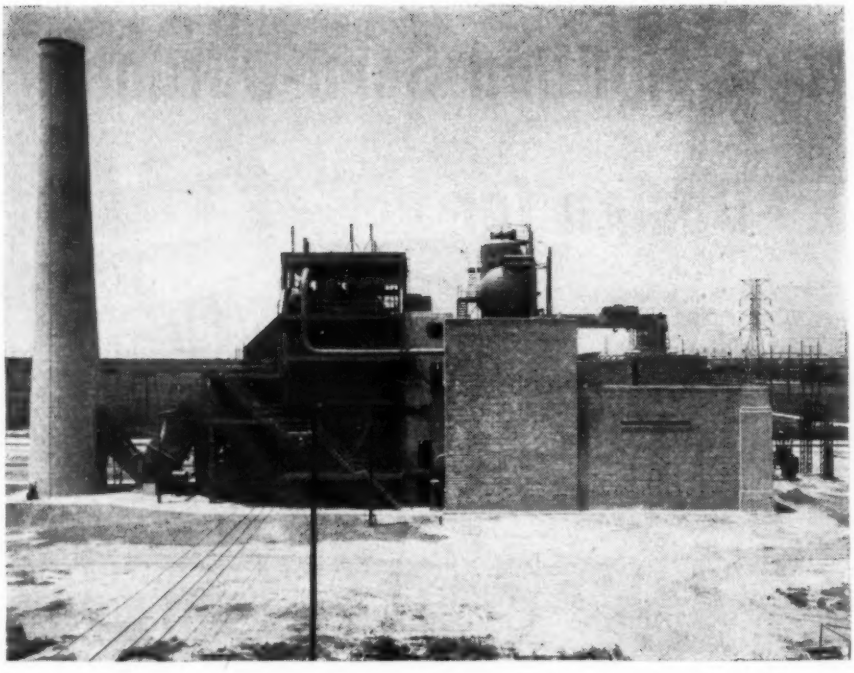


Fig. 2—Characteristic design of small-volume building and outdoor boiler unit covered only by a simple concrete slab at 35,000-kw West Junction station, Texas

Plant Arrangement

Fig. 1 shows the 86x91x30-ft-high station building in the background with details of the outdoor boiler, fans and circulating pump in the foreground. The "basement" of the plant is at grade elevation. Turbine-generator is located on the roof deck in the background, under the gantry crane.

All exposed steel, including the entire boiler, is painted light gray. The building's red brick panels contrast with its white reinforcing columns. Aluminum painted safety-valve vents project slightly above the boiler canopy.

The 2300-v auxiliary switchgear is composed of factory-fabricated metal-clad air-circuit-breaker cubicles. Across a 5-ft aisle is the 440-v load center. Both sets of auxiliary switchgear are arranged most compactly in a 43x27x9-ft room.

From the centralized mechanical and electrical control boards inside the roof-top penthouse, normal communication is by means of a public-address system extending throughout the plant. Emergency speaking tubes lead from control

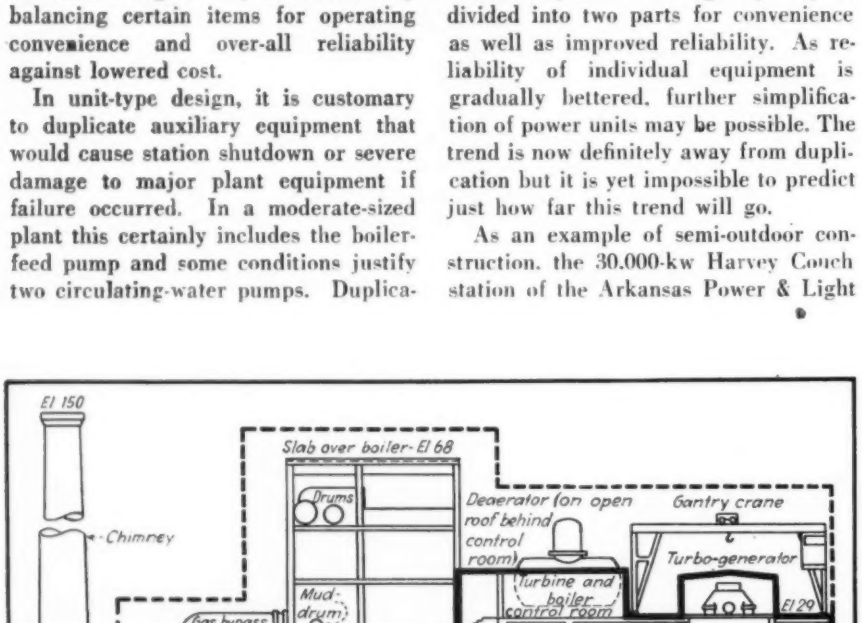


Fig. 3—Inclosure volume of typical semi-outdoor construction may be only one third that of conventional building with resulting saving of more than $5 per kw plant investment. Simplified plant layout can bring total saving up to perhaps 25%

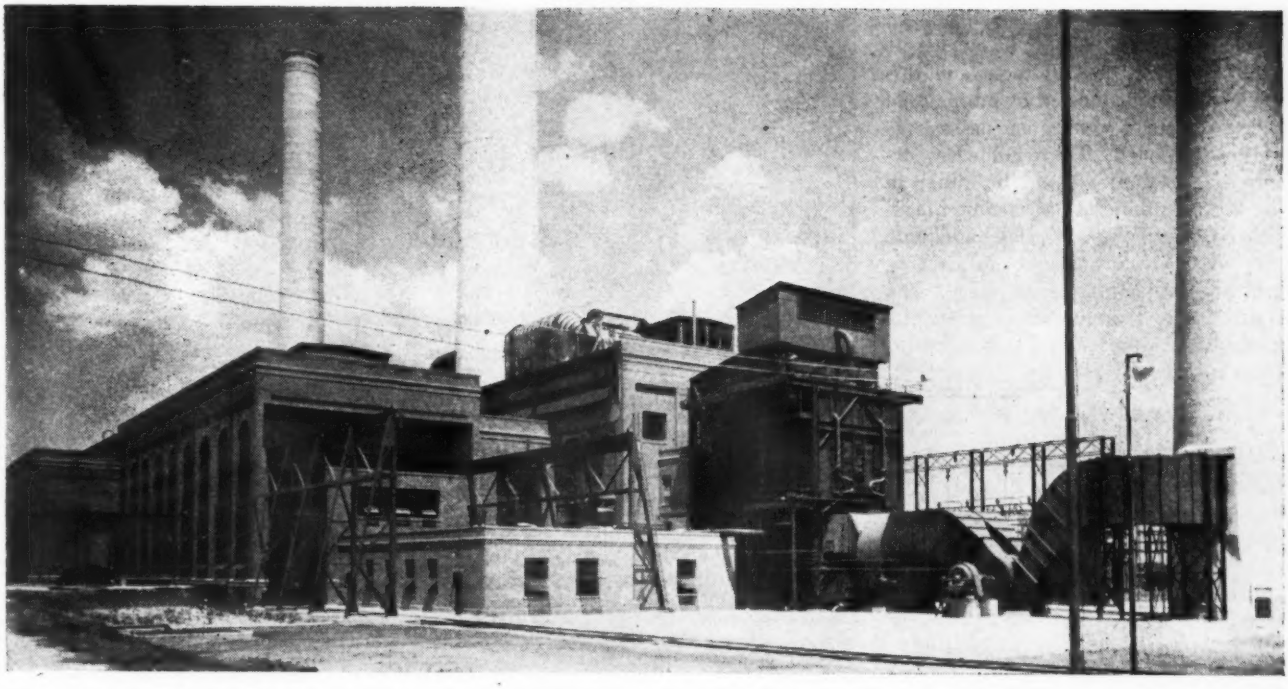


Fig. 4—To match existing floor levels of older conventional structure, new "basement" is actually below ground and turbine is housed in low brick structure. Existing crane moves through wall to position above 40,000-kw extension, Sterlington, La.

room to pump room, firing aisle and fan area.

Fig. 5 shows the turbine deck with turbine-generator inclosure, all roof sections of which can be removed after unfastening a few key bolted connections. Normally, only the section over the immediate working area must be removed—a simple operation for the gantry crane. Polarized plugs and receptacles facilitate disconnection of vent fans when removing and replacing roof sections. One end of the housing is also removable to allow handling of the generator field. In event of inclement weather while maintenance work is in progress roof sections can be set in place quickly and require no immediate bolting.

Antifreeze Precautions

Small light bulbs in the gage-glass housing for the deaerator, shown in the foreground of Fig. 5, provide not only illumination but also heating for protection against moisture condensation and freezing, precautions also taken in other outdoor parts. Floodlights installed at important locations around the plant and on the gantry crane insure adequate illumination for routine operation and necessary maintenance work at night.

A hatch in the turbine deck allows the crane to lower parts into a repair space in the "basement" at ground level. Another hatch gives access to the auxiliary switchgear room, and a third provides for removal of the high-pressure-heater tube assembly by means of the crane.

In the basement are the normal motor-driven pump auxiliaries and piping connections. Ample space is provided for usual operating movements as well as for pulling condenser tubes and for other repair activities. Under the turbine pedestal are generator hydrogen and CO_2 cylinders, manifolds, seal-oil hydrogen detraining tank and associated apparatus. Above these are the generator field switch, motor-operated rheostat, neutral reactor and concrete compartments for potential transformers, capacitors and lightning arresters. Working space for general repairs can be reached by the gantry crane through the roof hatch; a railroad spur track extends into this area of the building for delivery of heavy material.

An outdoor substation serves the outdoor-type 440-v load center at the cooling tower, some 240 ft from the station building. Contactors are housed in weatherproof boxes, grouped for each four cooling-tower fan motors.

The plant's three major operating points—control room, turbine generator position and boiler firing aisle—are in close proximity. This lends itself to economy of personnel. At Harvey Couch station, Ark., for example, 25 men comprise the entire operating and maintenance staff. Four handle supervisory and office work, six are assigned to maintenance and the remaining 15 operate the station. Among the latter are a janitor, a wiper and a yard man; this leaves twelve shift operators—three regular operators for each 8-hr shift, with relief. One operator is stationed at the combined mechanical-electrical control room in the penthouse, one covers the condenser and pump room at ground level and the third is free to move about the plant for general operating routine. This is considered an unusual accomplishment in simplicity and economy of manpower.

The plant has been in commercial service since October, 1943, and because of low fuel cost operates continuously at approximately rated capacity on base load. Experience indicates an entirely satisfactory degree of reliability.

Experience

For more than eight years successful operation of Orem station, a pioneer semi-outdoor plant at the mouth of the Provo River Canyon in Utah, has demonstrated the suitability of such construction in rugged climate, with perpetual snow in the adjacent mountains. The 18,000-kw stoker-fired 450-psi 750-F plant was built with boiler base and firing aisle totally inclosed and a brick structure to house the turbine-generator. Turbine work is handled by a gantry crane through removable roof hatches—forerunners of today's light, removable roof sections.

West Junction, just outside Houston, Texas, offers entirely different climatic conditions for another example of semi-outdoor construction completed in 1943. The 35,000-kw turbine-generator is located as at Harvey Couch, in a re-

movable-sectioned-metal housing, and the boiler is protected only by a concrete slab. However, control room and turbine house are connected by an inclosed walkway instead of an open passage as at Harvey Couch. The windowless design of the small-volume building, in Fig. 2, was prompted by wartime blackout requirements. It has adequate forced ventilation although no air conditioning or cooling is provided. The auxiliary bay structure rises above the turbine level sufficiently to allow use of a one-legged gantry crane.

Plant Extension

Adaptability of semi-outdoor construction to extension of existing conventional steam stations is demonstrated by a 40,000-kw addition, completed in 1943, to the Sterlington station in Louisiana. Contrast in building arrangement between the older structure and its extension, Fig. 4, is striking.

To match the existing plant, the basement for the extension is below ground level. The boiler base is at grade level, and the turbine-generator also stands at grade elevation in a low brick structure. In Fig. 4, the outdoor 800-hp induced-draft-fan motor stands at the right of and adjacent to the horizontal regenerative air preheater. The existing turbine-room crane has been revamped for outdoor service and its rails extended on a trestle. A rolling steel door in the existing building wall allows the crane to pass from the inclosed turbine room to a position above the new building where hatches permit handling of turbine-generator parts.

Corrugated transite penthouse above the boiler, Fig. 4, protects the superheater header, which in this particular design is above the single drum. All boiler casing was fabricated of transite because of the critical steel shortage.

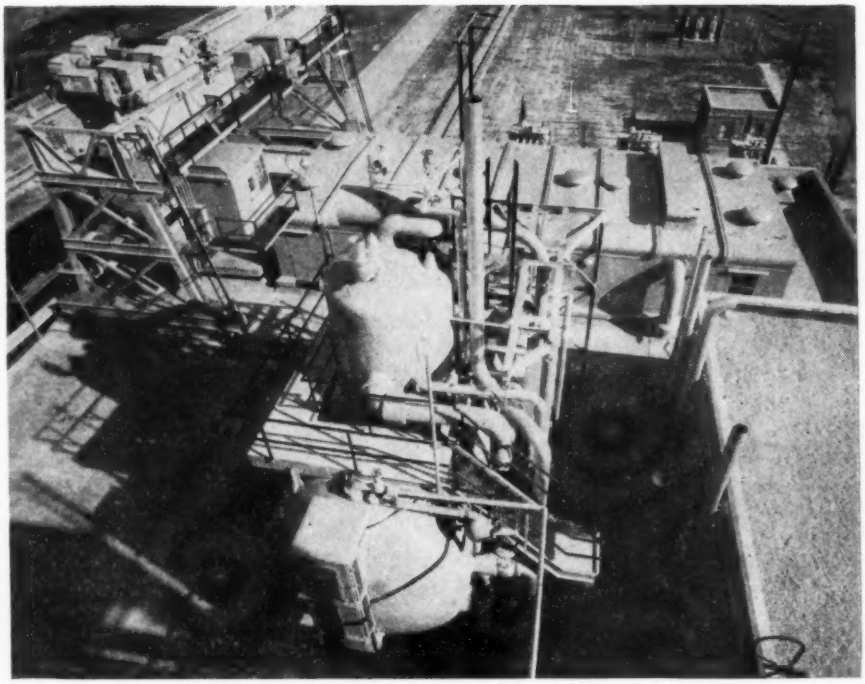


Fig. 5—Turbine-generator housing has removable roof sections held by a few key bolts. Floodlights on gantry crane provide adequate illumination for night work

For semi-outdoor designs, construction stages differ somewhat from the conventional that engineers have come to expect. Instead of digging a hole first, the site is normally graded and any needed piles driven. Next, the turbine pedestal is built in the open, to the wonderment of those who have not seen the construction plan. This is different from the procedure where the building goes up first to house equipment.

Building sections are placed after certain larger pieces of equipment. For instance, the condenser is skidded into place before the wall is closed in. Metal-clad switchgear and factory-assembled switchboards are usually installed in completely fabricated blocks, after which walls are built around them and hatches are provided for later access.

As the heavy generator stator is normally handled only once, it can be raised into position by gin poles or by jacks, with resulting savings in size of gantry crane.

During construction, a locomotive crane is extremely useful, operating on temporary track laid along the outside of building areas. It can handle all usual items such as auxiliary switchgear, circulating-water pipe and pump, equipment parts, and is useful for many other construction operations.

Editor's note: The semi-outdoor plants described in this article were designed and construction was supervised by Ebasco Services Incorporated for client operating companies.

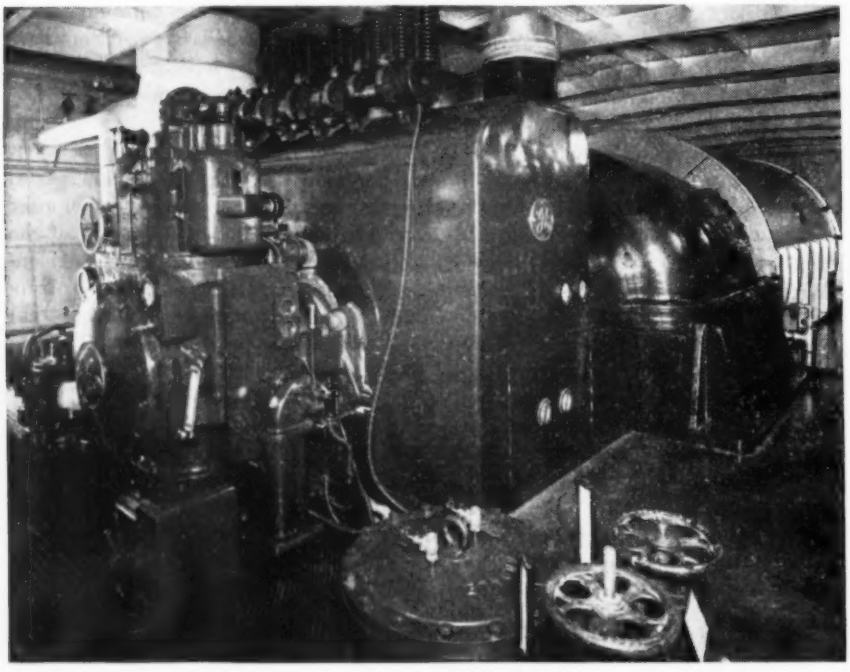


Fig. 6—Turbine-housing interior affords sufficient space for normal operating activities. Neither heat nor noise conditions have so far been found objectionable

Magnetic and Fluorescent Inspections Prevent Service Failure

Such nondestructive tests are particularly effective for turbine blades but work as well for other machinery parts. Hamilton Migel, Magnaflux Corp of New York, details application and technique

Fig. 1—Caustic embrittlement of riveted boiler drums shows up clearly under Magnaflux test. Note clear indication of cracks even in photograph

▶ MORE EXACTING REQUIREMENTS for materials and parts of highly stressed modern equipment lead to more widespread use of nondestructive tests for new equipment before shipment and for routine examination as maintenance procedure. While the basic fundamentals of magnetic particle inspection have already been described (POWER, March, 1937, page 144, 145) new methods and new techniques have been developed to better adapt established methods to power-plant problems.

New parts and machinery are inspected to insure that there are no defects in original material and that no detrimental effects have resulted from fabrication. However, nondestructive inspection has become even more useful as preventive maintenance in locating near-invisible cracks, which have developed in service and which would cause failure if not found at an early stage.

Working Principle

Magnetic-particle inspection (Magnaflux*) has been used for more than a decade to locate defects at or near the surface of magnetic materials. In principle, a crack or discontinuity that cuts across the magnetic field acts as an obstruction to deflect the field through the surface of the part and create local poles which attract and hold magnetic particles. An accumulation of particles shows up defects that would otherwise be difficult or impossible to see.

The particles may be used in the form of a dry powder or they may be suspended in a light kerosene-type oil. For the dry method, particles are somewhat larger than for the suspended-oil procedure. The dry technique is well adapted to inspection of large parts, rough surfaces, or where maximum sensitivity is required for locating relatively large subsurface defects. The wet method is particularly effective on smooth or machined surfaces to show up very fine discontinuities.

In either method particles should be of a color providing maximum contrast with the background. For surfaces difficult to inspect, wet-method particles can be coated with a dye which fluoresces brilliantly when exposed to ultraviolet light.

In either method particles should be of a color providing maximum contrast with the background. For surfaces difficult to inspect use of particles coated with a fluorescent dye (Magnaglo) is more effective. When exposed to near-ultraviolet light the particle patterns fluoresce brilliantly permitting them to be easily and rapidly detected.

It is essential that the magnetic field be at an angle to the crack or defect. A *longitudinal* magnetic field parallel to the axis of the part is used for the detection of *transverse* defects. This is normally produced by placing the part in a coil. For detection of *longitudinal* defects a *circular* field is used. This is produced by passing the magnetizing current through the part itself or through a conductor threaded through an opening in the part. In each case the magnetic field is at right angles to the current flow. A simple rule of thumb is: For best indications, the magnetizing current should flow essentially parallel to the direction of the expected defect.

Simplest and most effective magnetization is produced by high-amperage low-voltage currents. Alternating current has a "skin effect" and fields produced are at or near the surface of the part, appropriate for surface defects. For greater sensitivity to subsurface faults some form of direct current is best. It makes no difference whether the supply is taken from batteries or is rectified ac. Sensitivity is also increased by using a high-amperage surge for a fraction of a second, then dropping to a lower steady-current value, or by using half-wave current.

Magnetic particles are usually applied while magnetizing current is flow-

* Magnaflux, Magnaglo and Zyglo are registered trade marks of Magnaflux Corp applied to its equipment, materials and methods

ing, the so-called *continuous* method. In the *residual* method, applicable to high-carbon steel or alloys of good magnetic retentivity, the operator applies the inspection medium after the current has been turned off. The latter procedure is somewhat less sensitive but often provides adequate definition of the defects being sought.

The amount of current needed to assure sufficient magnetization is often a subject of controversy but actually is not a particularly critical factor. For large machinery or heavy structures 100 to 400 amp per inch of part diameter provides sufficient field for circular magnetization. For longitudinal fields 100 to 400 ampere-turns per inch of coil diameter is adequate.

Local Magnetization

For very large castings or heavy welds it is often impractical to magnetize the part as a whole. Effective circular magnetization can be produced in local areas by the *prod* method. Two electrodes are placed on the surface of the area being inspected from 5 to 10 in. apart and a current of 300 to 600 amp passes through the electrodes and the part. Current should pass as nearly as possible in a direction parallel to the suspected discontinuities. Heavy sections require higher amperage and closer prod spacing than thin sections.

Magnetic-particle inspection is particularly effective for turbine blades. Standard practice calls for a longitudinal field produced by dc and inspection by the continuous dry method. The field can be set up in a group of blades by a simple coil, Fig. 2. A mechanical powder blower or hand spray bulb dusts the surfaces with magnetic particles. After excess powder has been blown off indications of fatigue cracks are readily detected.

Inspection of large machinery parts for surface or fatigue cracks is equally simple. Discontinuities in these parts are almost invariably transverse to the axis of the part and longitudinal magnetization by coil is usually sufficient. While dc is best for turbine blades because of better field distribution, ac is normally used for maintenance inspection of other types of equipment since fatigue cracks start at the surface. The dry continuous technique is usual although the residual method often gives adequate indication. Use of ac also has the advantage that parts can be demagnetized by the same equipment after inspection.

Application of magnetic-particle testing to welding has expanded rapidly during the past few years. The methods

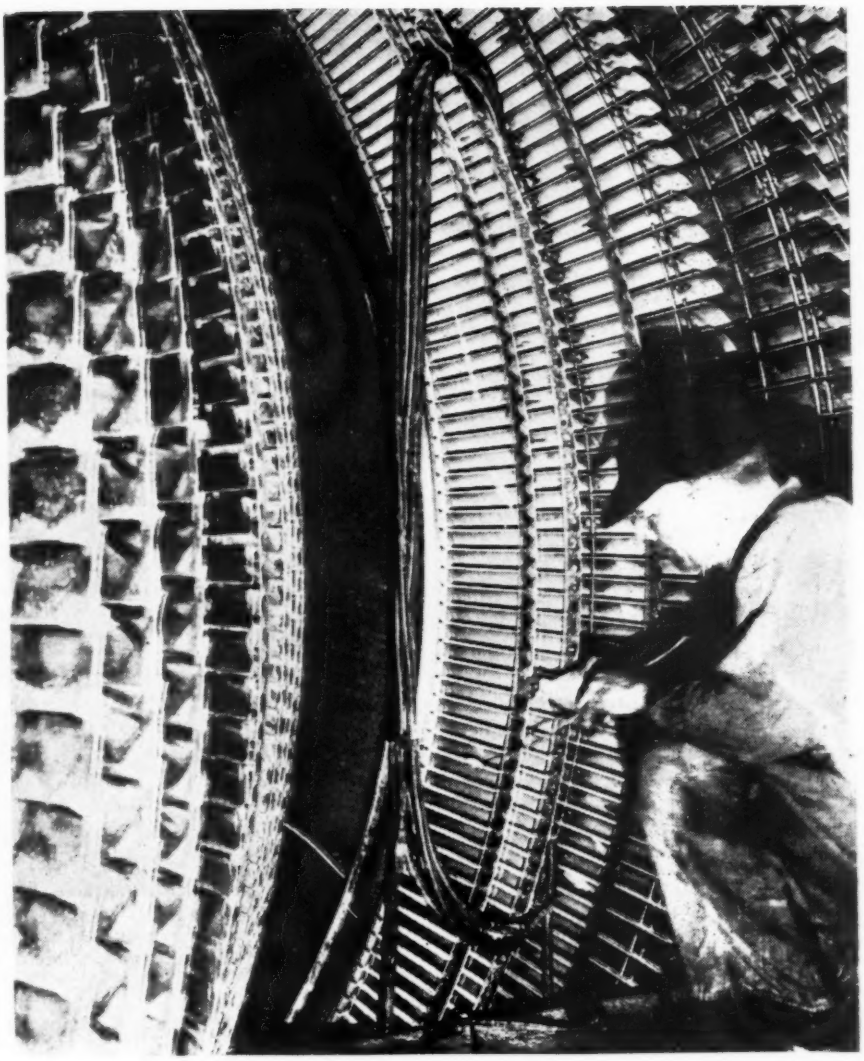


Fig. 2—Circled coils of wire carrying heavy current produce the magnetic flux for dry-powder check of this 60,000-kw-turbine spindle blading

are particularly well adapted to finding fine surface cracks not seen by visual examination and often difficult or impossible to find by radiographic methods.

For heavy welds, the prod technique is almost universal, with the current passing parallel to the axis of the weld. Use of surge or rectified half-wave current aids in locating defects below the surface. Welds on irregular shapes or around manholes, difficult to check by other nondestructive tests, can readily be examined by magnetic inspection.

In many cases it has been found economical to use magnetic methods of inspection and complete repairs before X-ray examination. This eliminates almost all harmful defects before the more expensive radiographic test and greatly reduces the number of X-ray retakes. Since two men can inspect from 50 to 100 ft of weld with about a dollar's worth of material in an hour, the cost of magnetic inspection is relatively low.

Magnetic and radiographic inspections of welds are not mutually competitive since each has maximum effectiveness for different types of discontinuities. The two inspections supplement each other in the field of weld examination.

For locating defects in nonmagnetic materials, a fluorescent penetrant method (Zyglo) has recently been developed that finds cracks or other discontinuities open to the surface in any solid material. The inspector applies a penetrating liquid containing a highly fluorescent dye. Because of its viscosity and surface tension, the penetrant is drawn into a crack by capillary action.

After a period from one minute to several hours, depending on the type of material, all traces of the water-washable penetrant are removed by a spray. This operation is usually done under ultraviolet light to assure that no traces of penetrant remain on the surface of the material.

The part is then dried of the wash

water (not always necessary) and a developing material is applied to the surface to bring the penetrant back out of any discontinuity in the part. Examined under near-ultraviolet light, cracks show up with a brilliant fluorescent indication.

This procedure is now being applied to production inspection of aluminum, magnesium, tungsten carbide, bronze and stainless steel. It is equally effective for glass, plastics or ceramics. Also, by applying penetrant to one side and developing material to the other, leaks in tanks or castings of any material can be readily detected.

Alloy-Blade Inspection

Of particular interest to power engineers is application of the fluorescent inspection to nonmagnetic alloy blading of large turbines. The blading is thoroughly cleaned, usually by flyash, of any material that might interfere with the penetrant entering a fatigue crack. Liquid is applied by a simple spray gun. After an hour or so blades are washed by hosing with warm water.

After examining with near-ultraviolet light to assure effectiveness of the wash, the blading stands until dry, or an air dryer can be used to speed the process. Developing powder can be applied by a small spray bulb. After a half hour developing time, a portable black light gives instant indication of cracks.

It is not necessary to have absolute darkness for the use of black light. Shading the area with tarpaulins is usually sufficient. Radiation produced by the portable near-ultraviolet units, while beyond the visible range, is not injurious to personnel and does not cause "sunburn."

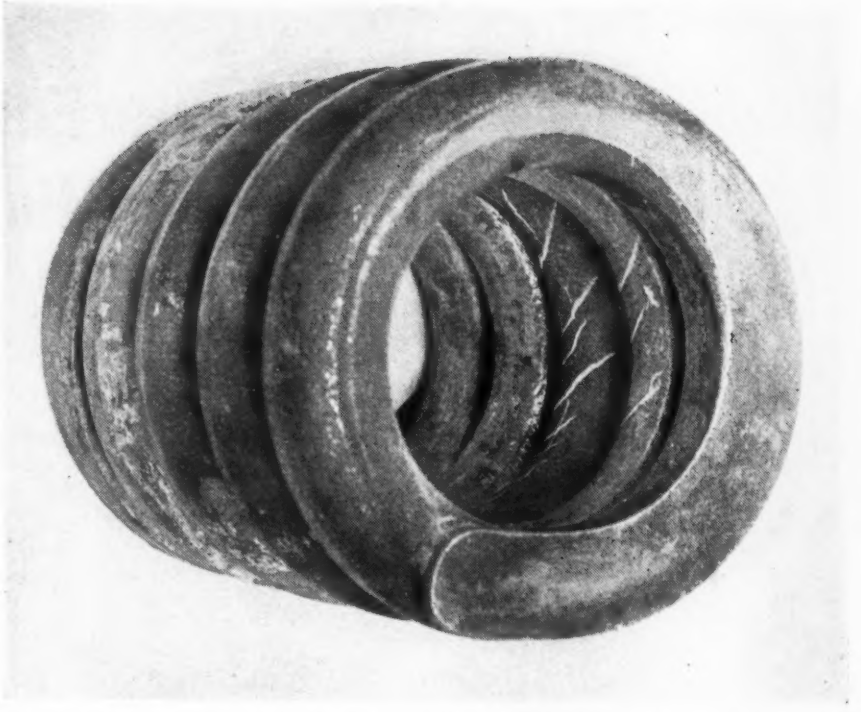


Fig. 4—Typical dry-powder indication of fatigue cracks in a heavy spring. This method can be applied to parts or assemblies of practically any shape or size

Application of fluorescent inspection is not, of course, limited to turbine blading. Black light inspection can be used effectively in overhaul or maintenance work on such items as aluminum pistons or stellite valve trim, stainless-steel or other nonmagnetic welding or brazing. It has even been used for checking ceramic electric insulators.

These nondestructive tests, both magnetic and fluorescent, have long since proved their worth as useful tools in "production" inspection. They are being used to a considerably greater extent in "maintenance" inspection. However, they do not always give a yes-or-no answer and require trained and competent inspectors for application of the methods and interpretation of results.

Men must be familiar with proper techniques for magnetization and for application of inspection mediums. Training is relatively simple once operators thoroughly understand the basic principles.

Interpretation of the results is somewhat more of a problem. Knowing what kind of discontinuity is being shown by a given indication requires a background of experience. For example, it is important to differentiate between the indication produced by a nonmetallic inclusion and the indication resulting from a grinding check.

Furthermore, evaluation of the effect of indicated discontinuities on the ultimate service life of a part requires precise judgment. These are sensitive "searching" methods that often show more discontinuities than those that seriously affect service life. A discontinuity is not a defect unless it endangers reliable future operation of that particular part. For example, a round-shaped nonmetallic inclusion may not be at all serious while a sharp notchlike grinding check in the same part may be a starting point for a fatigue crack.

The value of these methods in the important field of preventive maintenance is best indicated by rapid expansion of their use during the past few years.

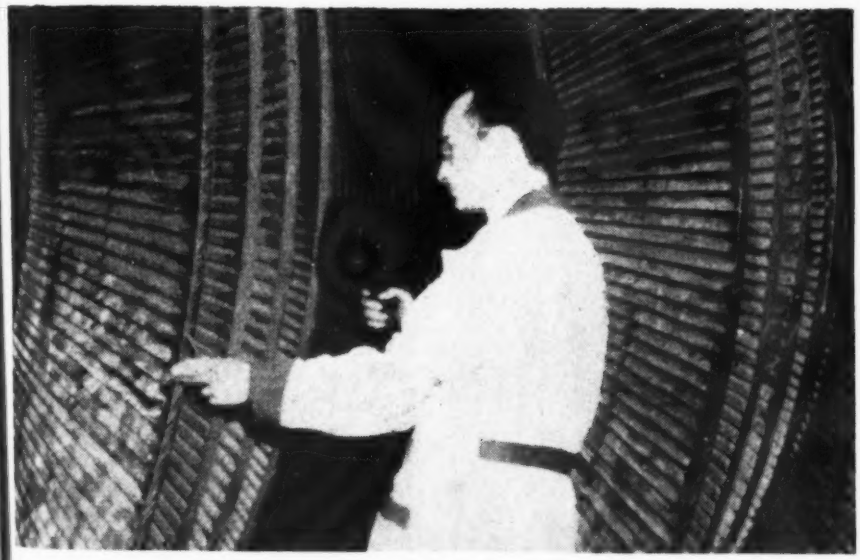


Fig. 3—Ultraviolet rays from the portable lamp in the inspector's right hand readily detect fluorescent indication of cracks in turbine blades or shrouding

Kobuta Plant Treats Enough Water For a Million Homes

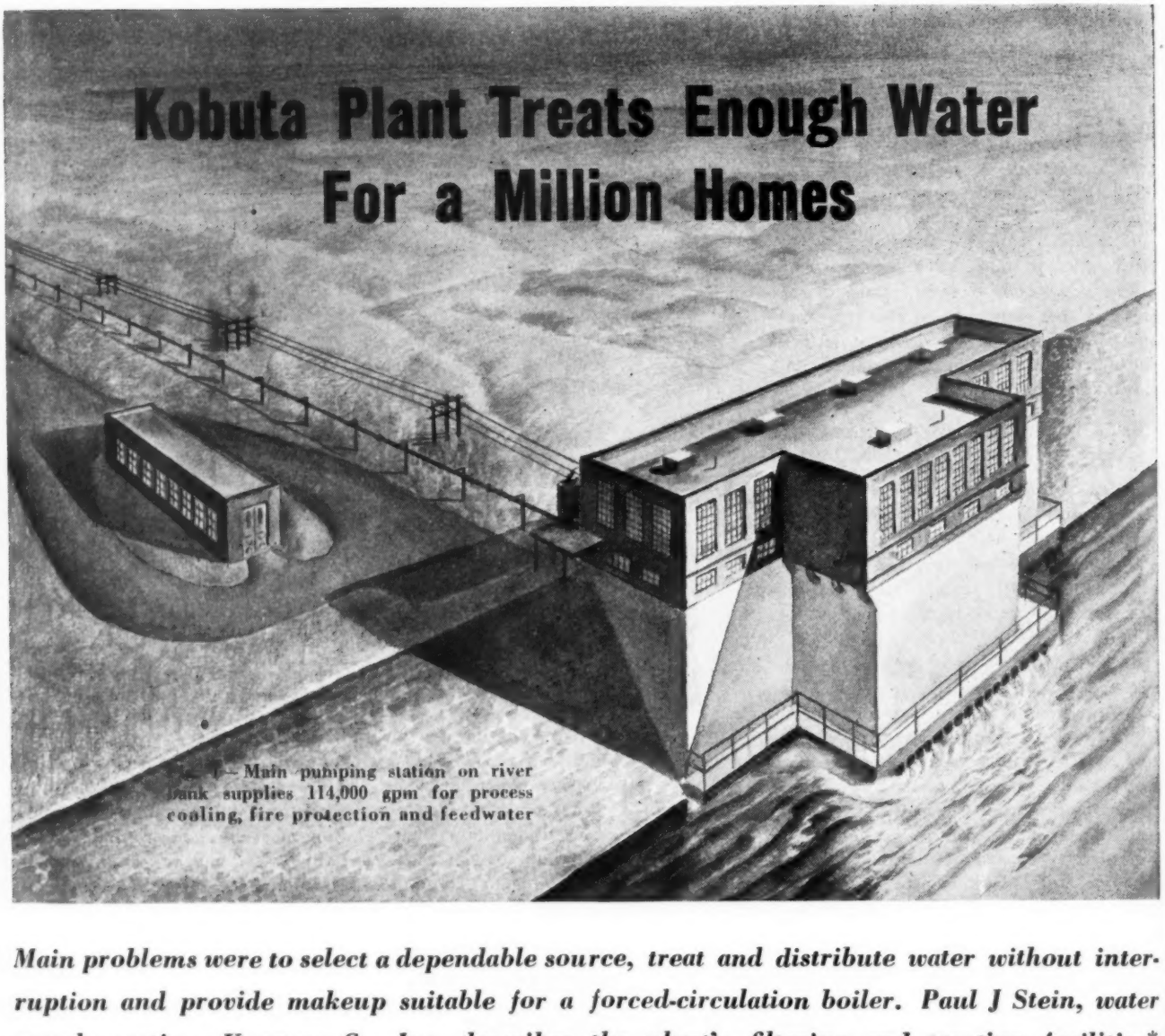


Fig. 1—Main pumping station on river bank supplies 114,000 gpm for process cooling, fire protection and feedwater

Main problems were to select a dependable source, treat and distribute water without interruption and provide makeup suitable for a forced-circulation boiler. Paul J Stein, water supply section, Koppers Co, Inc, describes the plant's filtering and treating facilities*

►On the Ohio River's southern bank stands the huge project that Koppers Co, Inc, operates for the Rubber Reserve Co, at Kobuta, Pa., to produce butadiene and styrene for synthetic rubber. The plant must treat a tremendous amount of water for the 120,000 tons of butadiene that it produces a year. To manufacture just one pound (see Table II), 1200 lb of water are needed for service and 35 lb for boiler use.

The pumping station is located upstream from the mouth of Raccoon Creek to insure against excessively high solids content entering from this heavily industrialized creek during dry periods and to procure a water that can be more accurately predicted. Thus the company sacrificed smaller capital investment, lower pumping costs, a more compact layout and greater ease in plant protection so that high-solids content would not jeopardize or seriously curtail operation of the entire chemical process.

Paul J Stein, as water-supply engineer, recounts the needs of this war plant

About 96% of water consumed goes for process cooling. Here basic treating requirements are not so severe as for boiler-feed purposes. Cooling water should be as cold as possible, free of large foreign particles and of algae growth, and non-corrosive. On the other hand, boiler feed requires water low in dissolved solids, suspended solids and scale-forming material. A disturbance to any of the chemical plant's basic utilities—steam, power and water—lasting only a few minutes can easily throw the process out of line so badly that it requires several hours to restore settings to normal.

Main pumping station Fig. 1, con-

*Abstract of a paper delivered at The 5th Annual Water Conference, Engineers' Society of Western Pennsylvania, Oct 31, 1944

tains six De Laval double-suction single-stage 900-rpm 20,000-gpm 278-ft-head centrifugal pumps driven by 1750-hp synchronous motors with direct-driven exciters. Two 13,800-v feeders from the power plant deliver electricity to the pumping station which consumes over 55% of the electrical energy required by the entire chemical works. Numerous relays and automatic devices provide ample protection for the machines.

Two motor-driven vacuum pumps, a steam ejector and a hydraulic ejector are available for pump priming. Vacuum system operates automatically through pressure switches and solenoid valves. To aid in maintaining steady pressure without dangerous surges in the distribution system, each pump is equipped with an S Morgan Smith oil-operated Roto-cone valve. With these valves a pump can be placed in or removed from service with only the slightest header-pressure fluctuation.

Valve-operating power is supplied from a separate oil-pressure accumulator capable of closing the six valves before reverse rotation of any pump can take place. A discharge check valve opens automatically when pump reaches full speed and closes when the unit is shut down or a power failure occurs.

Further protection against distribution-system surges that might cause disastrous results is provided by five S Morgan Smith surge-relief valves installed on the main discharge header. They operate on both low and high pressure in the water system as well as upon power failure.

Because a major portion of the chemical-works heat exchangers have non-ferrous tubes, corrision is confined to that part of the plant having steel-tube condensers. After the failure of several heat-exchanger tubes it was decided to install equipment to apply "threshold treatment" in one particular area. If the treatment proves beneficial it will be extended to protect other steel-tube units.

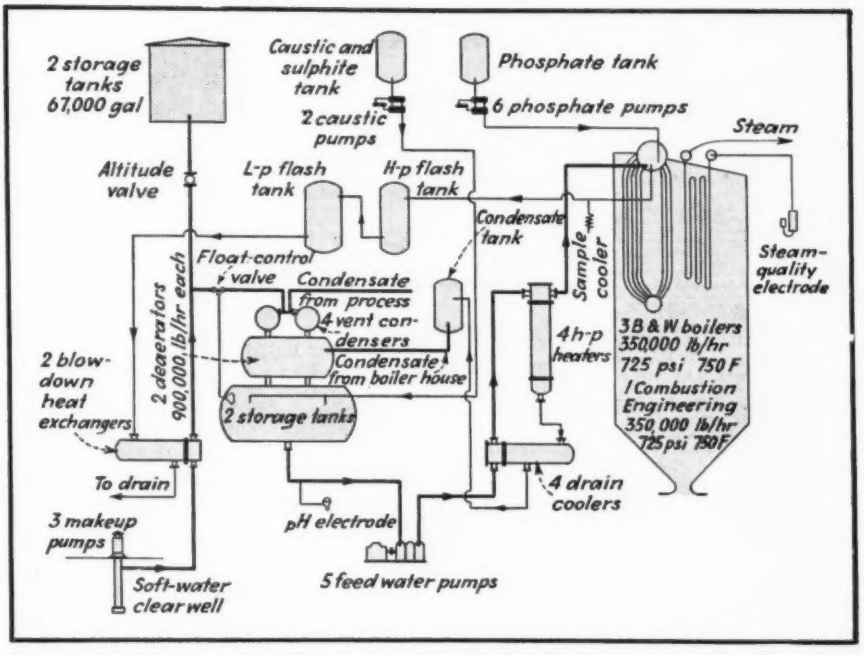


Fig. 2—Condensate and makeup pass through deaerators to storage tanks where caustic soda and sodium sulphite are added. Phosphate goes to each boiler drum

Control of algae growth is on a plant-wide scale. A Wallace & Tiernan chlorinator in the river pumping station feeds chlorine into the water for desliming. Under present conditions it operates for three 90-min periods each day. A careful test for residual chlorine leaving the various plant condensers assures feeding an adequate amount of chlorine to destroy algae and slime.

During the design and construction periods, it was planned to produce 80,000 tons of butadiene per year. Water-pumping facilities were conservatively designed to supply enough cooling water for this output. Because the demand for synthetic rubber soon increased it was imperative that every pound possible be produced. Output at Kobuta is now more than 50% greater than originally contemplated. Such a large production increase meant that the pumping station instead of having ample spare capacity was forced to operate at practically full output. During August, *operating pump hours* were 98% of the *available hours*. With special flood-protection design, it is not easy to remove the building wall and add another pump. Fortunately, the motors are not fully loaded, and larger pump rotors will be installed to increase the output by about 10%.

To obtain as much water as possible, in the meantime, the storage reservoir can be isolated from the distribution system. Thus by maintaining a lower discharge pressure, and hence a lower pumping head, pump output can be increased. This is only a temporary expedient that may be used should an emergency demand exceed available pump capacity.

While the basic treatment of screening, straining and chlorinating is sufficient for process water, an additional 4200 gpm must be conditioned for boiler use. Primary treatment occurs in the filtration plant, while internal drum-feeding equipment is situated in the boiler room.

Briefly, the power plant consists of four 350,000-lb-per-hr boilers designed for 725 psi and 750 F (POWER, Feb, 1945, p 64). Three are Babcock & Wil-

Table I—Comparison of Water Treatment Methods

Constituent	*Symbol*	*Raw water average ppm*	*Clarification filtration and zeolite softening ppm*	*Hot lime-soda process and filtration ppm*
Bicarbonate	(HCO_3)	7	0	0
Carbonate	(CO_3)	0	18	19
Sulphate	(SO_4)	96	115	96
Chloride	(Cl)	15	15	15
Silica	(SiO_2)	5	3	4
Iron	(Fe)	4	0	0
Calcium	(Ca)	23	1.5	6
Magnesium	(Mg)	5	0.5	1
Sodium	(Na)	23	76	62
Calcium Carbonate	($CaCO_3$)	78	6	19
Suspended solids		17	0	0
Total solids		195	229	203

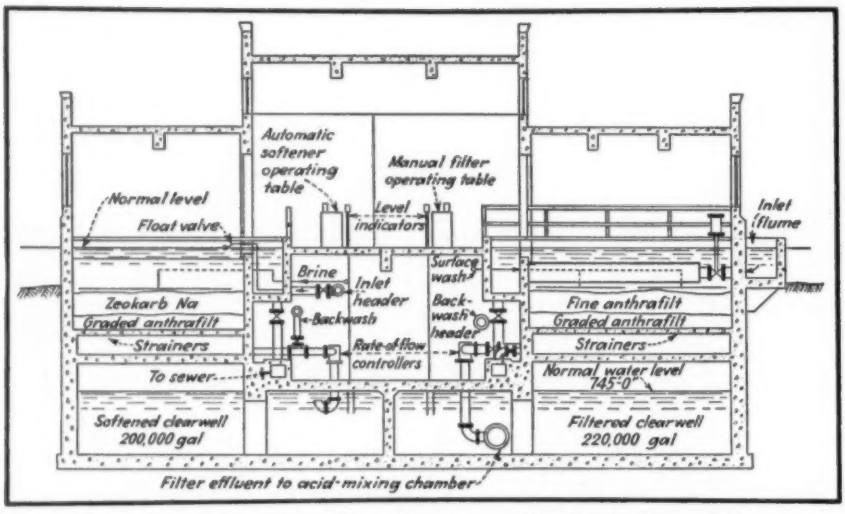


Fig. 3—Compact arrangement of filter plant locates filter and softener beds opposite each other. A special coating on cement walls prevents silica absorption

cox natural-circulation units, and the fourth is a Combustion Engineering forced-circulation boiler. A fifth unit (180,000-lb-per-hr, 450 psi and 460-F) just placed in service will increase steam capacity to 1,580,000 lb per hr.

The three conventional-design water tube boilers have offered no unusual problems in so far as water conditioning is concerned because operating information has been available. On the other hand, operating data on the forced-circulation unit using high makeup was not to be had. The government specified this type unit be built when steel demand was at its peak, because estimates showed that such a boiler would save about 40 tons of steel.

The only similar unit was installed in a large central station where evaporated makeup water amounted to only about 1%. With our requirements of 65%, conditioning required close attention. Early internal inspection of the unit revealed a flaky deposit of magnesium phosphate on the orifice strainers in the burner-wall water circuit. To reduce this deposit dolomitic lime, originally used to remove silica in the precipitator, was replaced by high calcium lime. With this change, magnesium sludge formed in the boiler water will precipitate as magnesium silicate. This is preferable to the magnesium phosphate.

Close vigilance is imperative because of the relatively small quantity of water in the boiler. With only 35,000 lb in a boiler capable of producing 350,000 lb of steam per hour, the solids concentrate at an amazing rate. When feeding water that has a solids concentration as high as 600 ppm at times and when maintaining a concentration of 2000 ppm, it is extremely easy for the boiler-water concentration to get *out of line* if the continuous blowdown is not properly set to maintain the delicate balance required. This unit, at one time regarded by many as an unknown quantity, is today consistently producing high-quality steam at high sustained ratings in a dependable manner.

In the feedwater cycle, Fig. 2, the water, after being heated and deaerated in Cochrane deaerators, passes through high-pressure heaters. The forced-circulation unit is equipped with an economizer. Therefore, it was of considerable importance to provide water with low residual hardness so that the efficiency of these heat exchangers would not be adversely affected. Raw river water contains mostly sulphate salts and is non-acid. Total hardness for the major portion of the year ranges between 70 and 90 ppm expressed as calcium carbonate, with little bicarbonate hardness present.

Composition, however, is quite variable, with dissolved and suspended solids reaching rather high values at times. Table III shows an average analysis which, together with other information available, determined the design of water-conditioning facilities. Because silica and iron content are relatively low, the problem resolved itself into one of clarification and hardness reduction.

From the standpoint of simplicity, installation cost and chemical cost, the hot lime-soda process probably would have been selected, if it could have been expected to take care of wide variations in turbidity, hardness and dissolved solids. But the importance of the installation would not permit the slightest possible gamble that might endanger production. Best possible makeup water had to be secured and there was a definite need for low-residual-hardness water. Thus high-pressure heaters and the economizer would perform more efficiently and require less cleaning.

Furthermore, small orifices, governing distribution in the various water circuits in the forced-circulation boiler, would be less likely to plug if the water contained less sludge-forming materials. This is extremely important where an accumulation of only a few pounds of suspended matter could cause considerable damage. To provide water having a residual hardness of less than 6 ppm, the clarification, filtration, and zeolite softening method was selected. Table I compares treated-water analysis for the clarification, filtration and softening method, with that expected from the hot lime-soda process.

Major equipment in filtration plant, Fig. 3, consists of: 3-1400 gpm Spaulding precipitators, 6 gravity-flow Anthrafilt filters, 6 gravity-flow carbonaceous zeolite softeners, 1 acid-mixing chamber, 1 Airveyor chemical unloader and several Toledo scales.

Chemical Control

River water goes to three 50x27x13-ft precipitators through a 20-in. pipe fitted with meters that control the rate of chemical input. Individual pumps feed lime, soda ash, and copperas as required. While raw water silica content is relatively small (5 ppm) provisions were made to reduce it by holding maximum flow rate through the precipitators to give 90-min detention. Precipitators are rectangular concrete horizontal-shaft agitator type with concrete vertical outer walls and bottom. Sloping baffles are made from waterproof plywood, whereas troughs are fabricated from cypress.

After being clarified and partially softened in its passage through the precipitators, the water flows by gravity to six Anthrafilt filters, Fig. 4. Each unit, an open concrete shell containing a number of layers of graded Anthrafilt, has an area of 375 sq ft. A concrete false bottom serves for the underdrains. Concrete sections, poured outside the filter, were installed with the necessary tie plates. As further protection against silica absorption in the filters, softeners and clearwells, all concrete is painted with a special coating.

After leaving the filters, the water discharges into the acid-mixing chamber where its pH is adjusted to 8.3. This prevents after-precipitation on the zeolite grains which, after a period, would reduce exchange value of the zeolite.

Table II—Service Water Distribution

Consumer	Quantity	Use
Butadiene	72%	Cooling
Styrene	24%	Cooling
Filtration plant	3%	Treatment
Boiler plant	1%	Ash removal
Hydrants and sprinklers	....	Fire protection
	100%	
Service water pumped (summer months)		110,000 gpm
Pumping capacity		114,000 gpm

Table III—Average Analysis of Ohio River Water

Constituent	Symbol	Ppm
Bicarbonate	(HCO_3)	7
Sulphate	(SO_4)	96
Chloride	(Cl)	15
Silica	(SiO_2)	5
Iron	(Fe)	4
Calcium	(Ca)	23
Magnesium	(Mg)	5
Sodium	(Na)	23
Suspended solids		17
Total dissolved solids		195
Soap hardness as $CaCO_3$		78

At rated capacity, acid-mixing chamber has a detention period of 2 min. Two propeller mixers provide adequate agitation. Leaving the chamber, the water flows over a weir into a clearwell, whence it is pumped to zeolite softeners. Piping arrangement prevents stagnation in the clearwell. If control fails, a standby acid-feeding system operated by a Permutit electro-chemical feed is available for pH correction.

Three pumps transfer the water to the softener units, each containing 500 cu ft of Zeo-Karb Na. The zeolite, supported on several layers of Anthrafilt, has a flow area of 200 sq ft and a filtering capacity of 600 gpm.

Each softener has an exchange capacity of 2,500,000 grains of hardness. Equipment design was based on the entering water having a hardness of 3¼ gr per gal (55 ppm). One unit can soften about 770,000 gal on each regeneration. Softeners are arranged in two groups of three units each with complete backwashing, regenerating, and rinsing facilities for each group, making possible regeneration of two beds simultaneously with complete automatic control for each bed.

Boiler makeup water is pumped from the softened-water clearwell to two Cochrane deaerators where it combines with condensate returned from the plant. Typical composition of the feedwater is as follows:

Makeup water		65%
Condensate:		
From chemical plant	15%	
From high-pressure heaters	14%	
From exhaust steam	6%	35%
		100%

Each deaerator operates at 10-psi pressure to remove the oxygen from 900,000 lb of feedwater per hr. To protect the equipment definitely against corrosion, sodium sulphite is fed into the deaerator storage tank. Caustic soda added at this point maintains a safe feedwater pH and alkalinity as it passes through boiler-feed pumps and high-pressure heaters.

Sodium metaphosphate fed directly into each boiler's upper drum by Proportioneer pumps satisfies the demand of residual hardness of the boiler feedwater. Boiler continuous-blowdown lines discharge into a 165-psi flash tank and then into the 10-psi flash tank, from which it passes through two blowdown heat exchangers to the sewer. Two Straub condensers with conductivity cells and recorders provide a continuous check on the quality of steam leaving the boiler drum.

Soda ash, lime and copperas delivered in cars are unloaded directly into storage hoppers by an Airveyor system. Jeffrey vibrators move the chemicals from the hopper to mixing tanks mounted on Toledo scales where they are weighed and dissolved in the desired proportion. Salt, for the regenerating brine solution also comes in cars that are unloaded into a basin alongside the railroad siding. Sulphuric acid comes in tank cars.

Sufficient flexibility has been incorporated into the treating plant to cope with practically all conditions that might be encountered. Also, the alterations that were required to satisfy the demands of the additional boiler recently installed were relatively small, consisting of a service-water pump and another transfer pump.

The contract for water-conditioning equipment was awarded to the Permutit Co, with the Hall Laboratories serving as consultants for Koppers Co, Inc. Sheppard T Powell represents the Rubber Reserve Co. Building was designed and built by Gibbs & Hill.

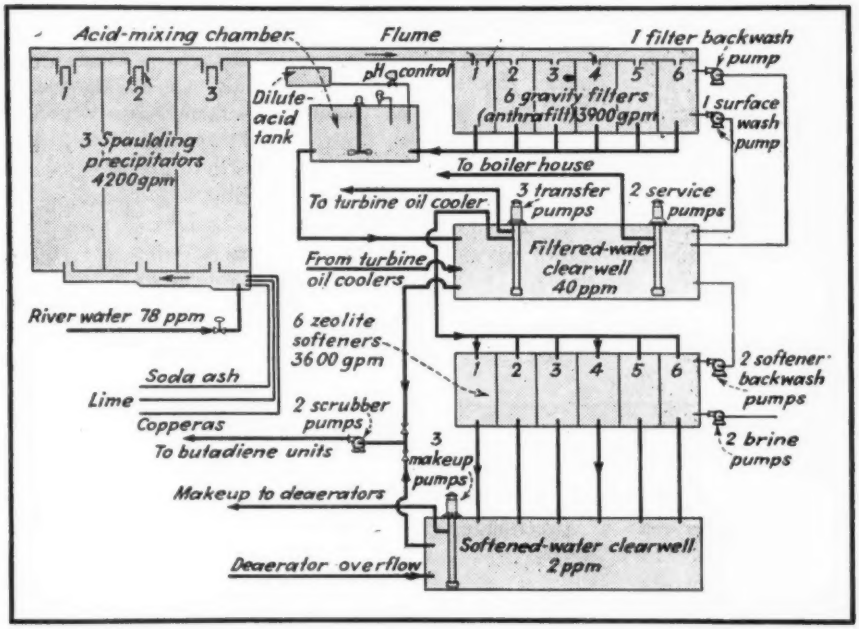


Fig. 4—Water leaves precipitators and flows by gravity to and through anthrafilt filter beds to clearwell. Pumps then lift water to zeolite softening beds

Natural-Gas Combustion Charts

Editor Phil Swain explains flue-gas-loss charts that are exact for methane and commercially accurate for any natural gas containing not less than 70% methane

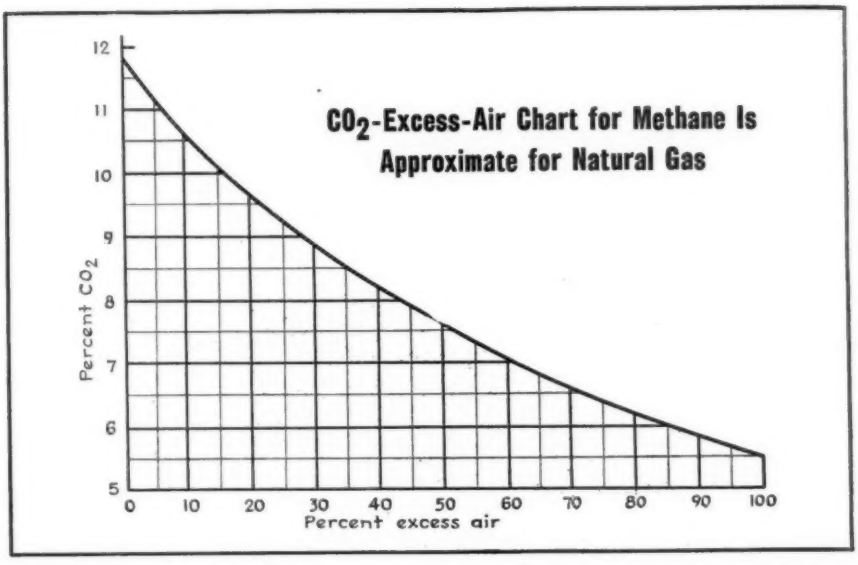


Fig. 1—Relation of CO_2 in flue gas to excess air when burning methane. This chart is a rough approximation for commercial natural gases containing over 70% methane. A later article will show how to derive a true curve for the actual fuel used

▶ THE MAIN COMBUSTIBLE CONSTITUENT in any natural-gas fuel is methane, for which the chemical formula is CH_4. This formula means that each molecule of methane gas contains one atom of carbon (weighing 12 atomic weight units) and four atoms of hydrogen (weighing one each). Thus the molecular weight of methane is 12 + 4 = 16.

Typical natural gases run anywhere from 70% methane (by volume) to more than 90%, so the engineer who knows what happens when methane burns is well on his way to an understanding of the combustion of natural gas. Working with methane alone, this article will derive relations that are reasonably close for any natural gas containing more than 70% methane.

How Methane Burns

Here are important properties of methane:

(1) Molecular weight, 16

(2) Weight per cu ft (at 160 F and 14.7 psi abs) 0.422 lb

(3) Heat value per cu ft (at 60 F and 14.7 psi abs) 1008 Btu

(4) Heat value per lb, 23,900 Btu

When methane is burned with the theoretical oxygen requirement, the equation of combustion is as shown in Table I, below.

In this table, note that cubic feet of each gas can be taken the same as the number of molecules in the chemical equation.

When methane is burned with air instead of with pure oxygen, each pound of oxygen brings in 3.3 lb of nitrogen, or each cubic foot of oxygen brings in 3.75 cu ft of nitrogen. This nitrogen goes through the combustion process unchanged, so it can be entered on both sides of the chemical equation, if desired, as in Table II.

From Table II, it is a simple matter to figure the products and the flue-gas analysis when methane is burned with the theoretical air. On a weight basis one pound of methane burns with 17.2 lb of air (4 + 13.2) to produce 2.25 lb water, plus 15.95 lb of dry flue gas, and releases 23,900 Btu.

On a volume basis, one cubic foot of methane burns with 9.5 cu ft of air, and produces 8.5 cu ft of dry flue gas (that is 1 cu ft CO_2, plus 7.5 cu ft N_2), while releasing 1008 Btu.

It is clear that the percentage of CO_2 by volume in the flue gas will be 100x1 ÷ 8.5 = 11.8%. The remaining 88.2% will be N_2. No higher CO_2 percentage than 11.8 is possible when burning methane.

Figuring the CO_2 percentage for any given percentage of excess air is not difficult. Suppose, for example, the excess air is 40%. Then the excess oxygen will be 0.4x2 = 0.8 cu ft. This will go through combustion unchanged, and show up as 0.8 cu ft in the flue gas. The additional nitrogen will be 0.4x7.5 = 3.00 cu ft. Then the dry flue gas will be:

	Cu ft	*Percent*
CO_2	1.0	8.2
O_2	0.8	6.5
N_2 (7.5 + 3.00)	10.5	85.3
Total	12.3	100.0

In the foregoing, the CO_2 percentage was figured as 100x1 ÷ 12.3 = 8.2%

Table I—Burning CH_4 With Theoretical Oxygen

CH_4	$+2O_2$	$=CO_2$	$+2H_2O$
1 molecule methane	+ 2 molecules oxygen	= 1 molecule carbon dioxide	+ 2 molecules water
1 cu ft	+2 cu ft	=1 cu ft	+2 cu ft (before condensation) (plus 1008 Btu)
1 lb	+4 lb	=2.75 lb	+2.25 lb (plus 23,900 Btu)

Table II—Burning CH_4 With Theoretical Air

CH_4	$+2O_2$	$+7.5N_2$	$=CO_2$	$+2H_2O+7.5N_2$
1 cu ft	+ 2 cu ft	+ 7.5 cu ft	= 1 cu ft	+ 2 cu ft* + 7.5 cu ft (plus 1008 Btu)
1 lb	+ 4 lb	+ 13.2 lb	= 2.75 lb	+ 2.25 lb + 13.2 lb. (plus 23,900 Btu)

* Here, as always, volume of water vapor, H_2O, applies only to the vapor stage. In ordinary gas analysis the moisture is condensed and therefore does not appear in the volumetric analysis.

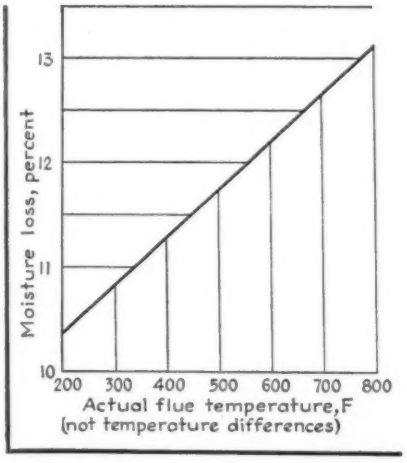


Fig. 2—Moisture loss from vaporizing and superheating the water produced by combustion of hydrogen in fuel. This convenient chart is exact for methane and not appreciably in error for any natural gas containing more than 70% methane

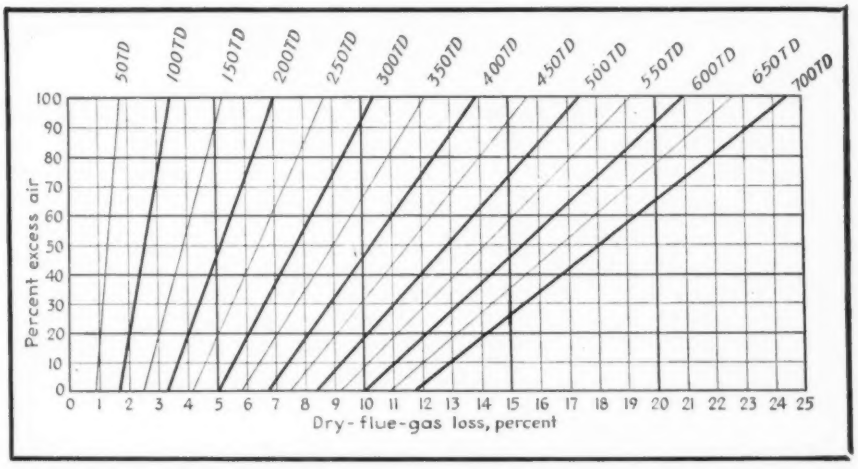


Fig. 3—Dry-gas loss. Chart gives percentage of heat in fuel wasted as sensible heat of dry-flue gas for various temperature differences. This is exact for methane and not appreciably in error for any natural gas containing more than 70% methane

and the O_2 percentage as 100x0.8 ÷12.3 = 6.5%

Repeating this computation for 20, 40, 60, 80 and 100% excess air gives the following for the combustion of methane, plotted in Fig. 1:

Percentage excess air	*Percentage CO_2 in flue gas*
0	11.8
20	9.6
40	8.2
60	7.0
80	6.2
100	5.5

Since the typical natural gas falls short of 100% methane by anywhere from 5 to 30%, it might appear that Table II and Fig. 1 would be in error by corresponding percentages if applied to a commercial natural gas. Actually, the results will be very much closer than that. However, the error may be appreciable. Fig. 1 may be used as a rough approximation for ordinary operating reports when burning natural gas. *Where practicable, however, prepare a curve like Fig. 1 for an average analysis of the actual gas used.* The computations required will be explained in a subsequent short article.

Figuring Stack Losses

Next, still working with pure methane, let's consider the flue losses for various stack temperatures and various percentages of excess air. Assuming complete combustion, the only important stack losses are the *moisture* loss and the *dry-gas* loss.

As to the moisture loss, note that the burning of one pound of methane produces 2.25 lb of water regardless of the percentage of excess air. The moisture loss arises from the fact that this water goes up the stack as a superheated vapor, thus wasting both its latent heat and its superheat. In Btu per pound of water this loss is 1000 + ½ T, where T is the actual Fahrenheit temperature.

Since one pound of methane produces 2.25 lb of water, the moisture loss per pound of methane will be 2.25x(1000 + ½ T) = 2250 + 1.12 T. This can be expressed as a percentage of the heat in the fuel. One pound of methane has a heating value of 23,900 Btu, so the *percentage* moisture loss is 100x(2250 + 1.12 T) ÷ 23,900, which reduces to:

Percent moisture loss = 9.4+0.0047 T.

For example, if methane is burned with a stack temperature of 450 F, the moisture loss is 9.4 + 0.0047x450 = 9.4 + 2.1 = 11.5%.

Fig. 2 plots this moisture loss to include the usual range of flue temperatures. The error in applying Fig. 2 to any commercial natural gas containing 70% or more of methane is too small to be of importance except in precise testing.

Next figure the dry-gas loss—that is, the loss from the heating of the dry-flue-gas constituents from room temperature to the flue temperature. The first step is to derive a table showing the weight of *dry* flue gas per pound of methane for various percentages of excess air. To show the method, the loss will be worked out for 40% excess air. Burning one pound of methane will then produce 2.75 lb of CO_2, 2.25 lb water (don't consider this as part of the dry flue gas) 1.6 lb of unburned oxygen and a total of 18.5 lb of nitrogen. This adds up to 22.8 lb of dry products.

It will be close enough to use the round number of 0.25 for the *specific heat*, the heat required to warm the flue gas one degree Fahrenheit. Suppose, then, that the temperature difference (flue temperature minus room temperature) is 400 deg. Then the heat waste will be 22.8x0.25x400 = 2280 Btu, and the percentage loss will be 100x2280 ÷ 23,900 = 9.5%.

Fig. 3 was computed in this way. It will be found reasonably accurate for any natural gas with 70% or more of methane.

It is important to note that Fig. 2 and 3 must be used with the actual heat value of the gas burned; never with the heat value of methane except where the fuel is methane.

To Sum Up

It has taken some space to explain how the charts were derived, but using them is extremely simple and rapid. Here's a sample problem:

A certain natural gas containing more than 70% of methane, and having a heat value of 925 Btu per cu ft, is burned under the following conditions: room temperature, 70 F; flue temperature, 450 F; CO_2 in flue gas 7.0%. Figure moisture loss and dry-gas loss in percentages and in Btu.

From Fig. 1, excess air = 60%. From Fig. 2, moisture loss is 11.6% of 925 Btu, or 107 Btu. Temperature difference is 450 — 70 = 380. From Fig. 3 the dry-gas loss is 10.4% of 925, or 96 Btu.

Note again that Fig. 2 and 3 are close enough for most natural gases, but that errors with Fig. 1 may be appreciable. A future short article will show how to prepare a curve like Fig. 1, to give accurate relation of CO_2 to excess air for a specific natural gas.

Automatic Field-Application Relay Puts Synchronous Motors in Service Quickly

Speed combined with time is the secret of synchronizing a motor quickly. W R Wickerham, Westinghouse control engineer, analyzes starting problems and tells how to apply field excitation when it will cause least power-system disturbance to synchronize the motor

► Because a synchronous motor must be brought to exact synchronous speed with relation to the power-supply generator, it has a more complicated starting cycle than other designs. The starter should bring such a motor into synchronism promptly when it has attained best speed for the purpose without causing excessive power peaks or loss of synchronizing torque.

A synchronous motor's starting cycle is completed in two steps: acceleration and synchronization. The motor is accelerated by applying ac power to its stator windings when its two field-coil terminals are connected to a suitable resistor without excitation current. During this period the motor operates like an induction motor. Acceleration period ends when speed becomes nearly constant. If the motor is loaded during acceleration, its highest speed is ordinarily between 95 and 98% of synchronous.

Presynchronous Speed

At this speed all torque is used by the load, windage and friction. To bring the motor to synchronism requires a synchronizing torque, which is developed when dc excitation is applied to the motor field coils.

Acceleration to synchronous speed after excitation has been applied must take place quickly; otherwise, the excited rotor poles slip past the stator poles. Slipping of excited synchronous-motor poles induces high circulating currents in the line that cause severe disturbances. With a given load inertia, the synchronizing torque required varies as the slip squared. It is therefore important that excitation application be delayed until the motor is running at its highest possible speed as an induction motor.

Time available for synchronizing depends on the relative position of stator and rotor poles at the instant excitation is applied, as well as the poles' relative speed. Lower portion of Fig. 2 diagrams a section of stator and rotor poles. Rotation of stator magnetic poles and the rotor is counterclockwise. Before the motor is synchronized, the rotor moves slower than the stator magnetic poles by an amount equal to the slip; consequently relative motion of rotor with respect to stator poles is clockwise. Therefore, in Fig. 2, rotor pole marked N moves to the right at slip speed relative to the motion of the stator poles.

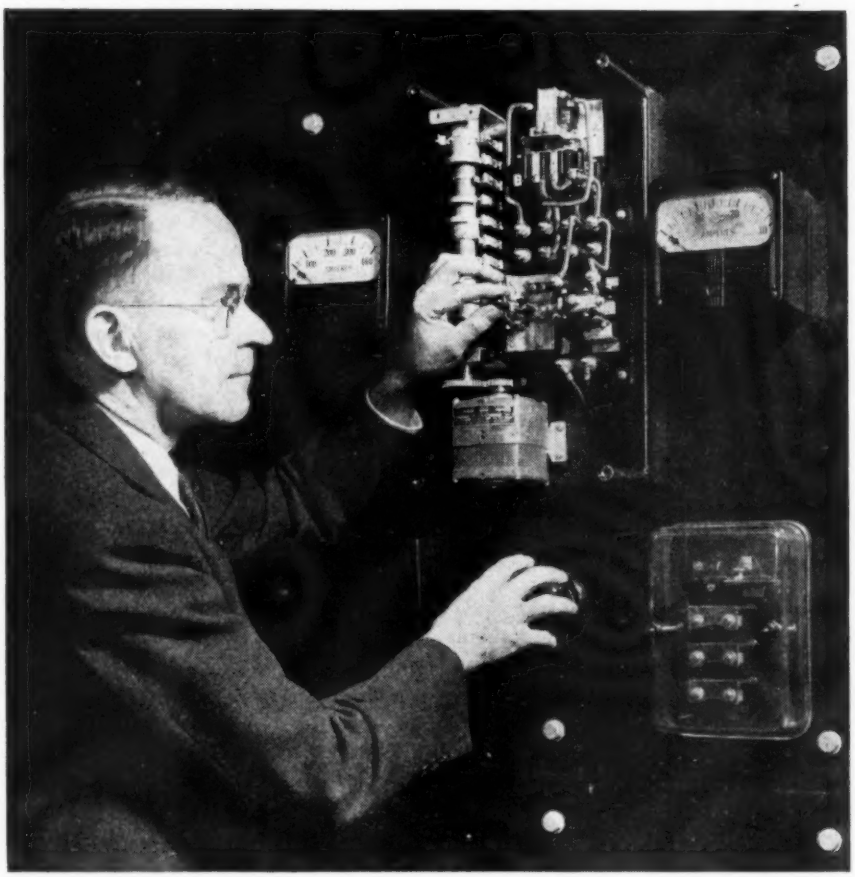


Fig. 1—Relay, combining a speed and a time element, closes synchronous-motor field-circuit switch at the instant when maximum synchronizing power is produced

In the left half of diagram, marked −180 to 0 deg, rotor pole N is approaching pole S in the stator, and this region is called the approach angle. In right half of diagram, marked 0 to +180 deg, rotor pole N is receding from S, and this region is called the recession angle. As rotor pole N moves still farther to the right, it approaches the next stator pole S (not shown) and thus the phenomenon is repeated for each pair of stator poles, that is, for each 360 electrical degrees.

Acceleration can take place only while unlike poles are receding from each other; that is, while rotor pole N is in the region A to B. Time available

for acceleration is maximum if excitation is applied when rotor pole *N* is approximately under stator pole *S*. If application of field is delayed until rotor pole *N* recedes from *S* through a considerable portion of angle *AB*, acceleration time is reduced since only the remainder of angle *AB* is available, which reduces the motor's ability to synchronize.

Curve in Fig. 2 shows variations in the motor's ability to synchronize when the field is applied at different pole positions. This curve was obtained by plotting maximum load torque that can be synchronized against pole position at which the field is applied. The torque has nearly maximum value, *C*, at beginning of the recession angle, and maximum time is available for acceleration. As the point of excitation application moves from *A* toward *B*, time available for acceleration is reduced, and minimum torque *D* occurs at about the recession-angle middle.

Applying Excitation

Applying the field in the recession angle beyond minimum torque point reduces acceleration time to a value where the motor cannot synchronize maximum load torque in the remainder of the angle, but must wait until the next recession angle. This means that it must slip through the entire approach angle so torque increases from the minimum to that obtained in the approach region.

Three methods of applying excitation to synchronous motors are: speed limit, time limit and a combination of these two. The first applies excitation when the motor reaches a given speed. Speed at which the field-supply relay must be set to operate is appreciably less than the motor can normally attain. If this were not done, an increase in load might prevent the motor from reaching a speed to operate the field relay. Therefore a speed-responsive relay alone requires that field current be applied at a greater slip than necessary, with attendant excess power peaks.

Time-limit relays apply field current after a definite time interval has elapsed, which begins with power application to the motor's stator windings. A fixed-time-limit device permits the motor to reach maximum speed, but it must be set to operate at the end of a period longer than the maximum expected accelerating period. This is necessary to avoid applying excitation too early during an abnormally long accelerating period. Since normal accelerating time is shorter than the longest expected, application of excitation in most instances is unnecessarily delayed.

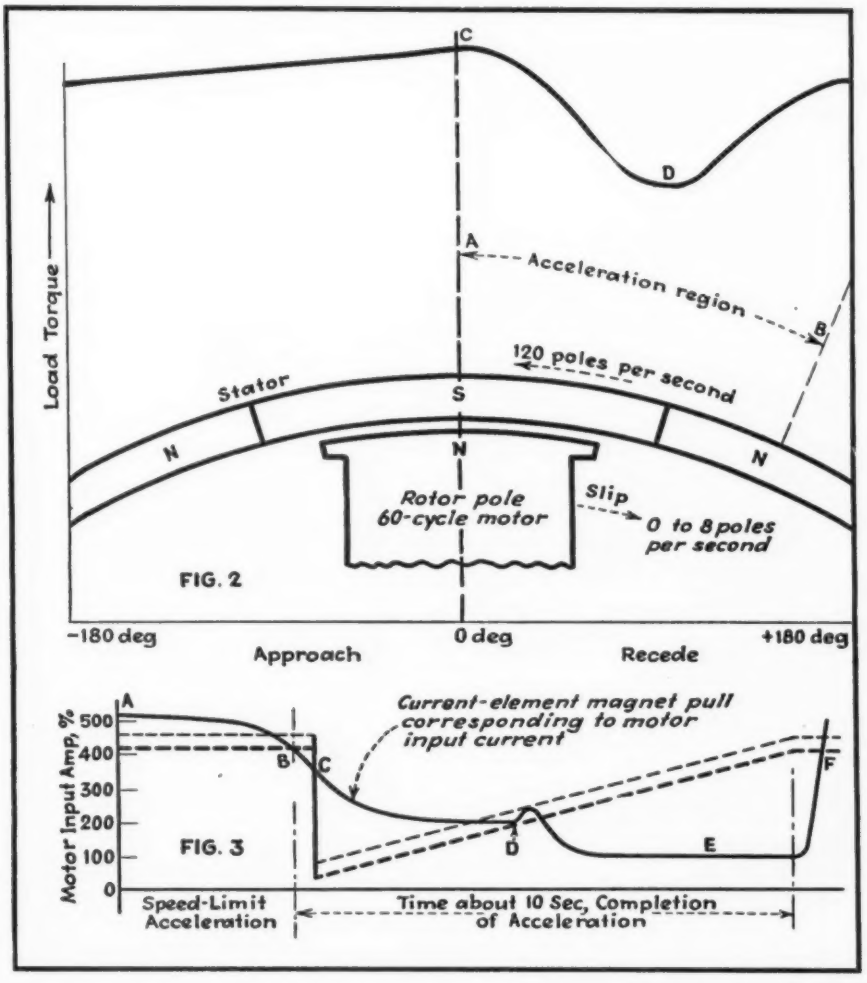


Fig. 2—Load torques that a synchronous motor can pull into step when its field-pole excitation is applied through full range of selective-pole positions. Fig. 3—Current-element performance of a relay that combines a speed and time element to apply field excitation at the correct time when starting a synchronous motor

Fig. 4 diagrams a synchronous-motor starting relay, applying field excitation under the most favorable circumstances. This requires that: (1) Motor reach maximum speed as an induction motor before field application. (2) Synchronizing be accomplished in minimum time consistent with maximum-speed requirements. (3) Synchronizing sequence be positive. (4) Unnecessary line disturbance and necessity for large synchronizing torque be avoided. (5) Automatic pull-out protection be provided.

To apply excitation at the highest possible speed without unnecessary loss of time, the relay has two elements, one responsive to speed, the other to time. Field application is governed by a motor-driven time element, brought into operation by the current-actuated speed-responsive element when the motor has reached about 90% speed.

This relay prevents failure to complete the starting sequence because its speed-responsive element can be set well below any slip speed at which the motor stabilizes. Time element is normally about 6 sec, long enough to permit acceleration through the final 6 or 8% speed. When full voltage is applied to the motor terminals the relay recognizes only speed acceleration until the motor reaches about 90% of maximum speed. Then the timing element takes over and applies field excitation when rotor and stator poles are in the most advantageous relative position.

Pressing the start button, Fig. 4, completes a circuit from *X* through the stop and start buttons, contacts 20–19 in the sequence-switch time element, coil *M* to the other side of the line at *Y*. Energizing coil *M* closes main contacts *M* to apply power to the motor's stator winding and closes auxiliary

contacts M_1, M_2 and M_3. Sequence drum fingers 20–19 are bridged only when the drum is in the off position to insure that the motor cannot be started unless the sequence-switch is in off position.

A current transformer through a copper-oxide rectifier supplies dc power to the coils of relay's current element *CE*. When full ac voltage is applied to the motor stator windings with the rotor at rest, magnetic pull of *CE* exceeds the tension of spring *S*, as at *A*, Fig. 3, and contact *E* opens. This opens the circuit of the relay's time-element pilot motor to prevent cam and sequence-drum-switch movement. Current-element cam and sequence drum do not move until the synchronous motor accelerates its rotor to about 90% of full rated speed.

Relay's Current Element

Magnetic pull of *CE* decreases slowly as motor speed increases until speed is about 75% of synchronous. Above this, relay magnetic pull decreases rapidly in the region of 85 to 95% speed, until at about 90% of full speed, spring tension exceeds magnetic pull and the relay contact *E* closes, point *B* on the curve, Fig. 3. When contact *E* closes it completes a circuit for the pilot motor from *X* through contacts M_2, *E*, CR_1, 16, 18, the pilot motor, back to the line at *Y*.

Energizing the pilot motor starts it turning the cam and sequence drum through one revolution. Drum movement of a few degrees causes finger 14 to make contact and connect the pilot motor across the line. This circuit is directly from *X* to 14 and 18, the pilot motor and to the line at *Y* to insure motor rotation until the cam and sequence drum return to their original position.

Within the first 30-deg rotation of the sequence drum, the end of tension-spring lever *L* drops off the cam and releases spring tension abruptly, as at *C*, Fig. 3. Magnetic pull of the current element now opens contact *E*, Fig. 4. While this contact is open, sequence-drum fingers 12 and 14 are in contact with the drum segments. Finger 12 closes the circuit for shunt relay coil *CR* from *X*, drum fingers *14* and 12, *CR* coil, M_3 contact back to *Y*.

Energizing this coil opens contact CR_1 and closes CR_2 and CR_3 so that the next time contact *E* closes, finger 6 is energized through CR_2 to close field contactor *MF*. After having been released, when the cam rotates about 30 deg, spring tension is gradually restored to its original value by the cam as it completes one revolution.

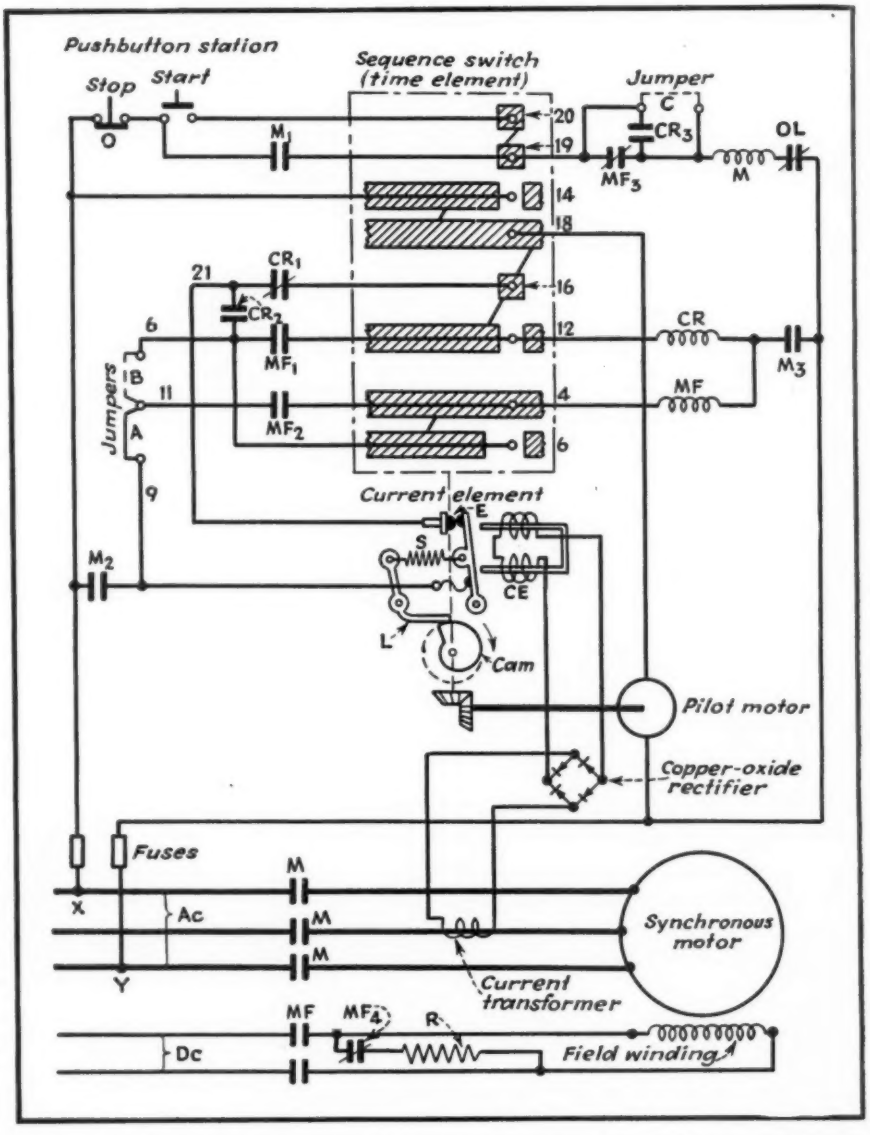


Fig. 4—Synchromatic relay connected to a control system for starting a synchronous motor on full line voltage with minimum disturbance in the power-supply lines

Current-element contacts *E* again closes when spring tension increases to where it overcomes the magnetic pull. By the time spring tension increases to equal relay *CE* magnetic pull, the synchronous motor has reached its maximum speed as an induction motor and the magnetic pull rises and falls periodically.

Relay *CE* is so adjusted that its armature drops out only when the magnetic pull is at one of its periodic low points as at *D*, Fig. 3. When contact *E* closes it completes a circuit from *X* through M_2, *E*, CR_2 sequence-drum contacts 6 and 4, coil *MF*, contact M_3 to the line at *Y*. Energizing coil *MF* closes contacts *MF* in the synchronous-motor field circuit to apply excitation to the motor. It also closes auxiliary contacts MF_1 and MF_2 and opens MF_3 and MF_4. The latter opens field-discharge resistor *R* circuit across the field coils.

When excitation is applied to the motor, current in relay coil *CE* assumes a constant reduced value corresponding to motor load current *E*, Fig. 3. Time-sequence drum and cam return to their original positions, so that spring tension greatly exceeds magnetic pull and contact *E* remains closed. Pilot motor stops when it turns the sequence drum one revolution because its circuit is open through contact CR_1. Relay *CR* is held closed by a circuit through contacts M_2, *E*, CR_2 and MF_1 coil CR and back to Y. Field contactor *MF* is held closed by coil *MF*, energized through a circuit from *X*, contact M_2, jumper *A*, contact

(*Continued on page* 142)

Furnaces Rebel Against Air Starvation

Getting air to the combustion zone ranks in importance with adequate fuel, and designers should consider the path of flow to assure operator comfort as well as ample supply

BY A G CHRISTIE
Professor of Mechanical Engineering
Johns Hopkins University

▶ SOME YEARS AGO the records of a large central station showed poorer boiler performance during late evening hours in winter than during the remainder of the day. One bitter evening a few frozen souls found it impossible to get into the boiler room by way of a large door that opened outwards.

Investigation showed that the large quantities of fresh air needed by the furnaces had to pass through the operating aisles. This made the area too cold for reasonable comfort of the firemen. All doors and windows were closed to shut off the cold draft. Partial vacuum produced by chimney draft was sufficient to prevent opening the large door, and furnaces were starved to the point of lowered combustion efficiency, as shown by the records.

This was not an isolated instance. Conditions were similar in a smaller stoker-fired industrial plant where the fresh air passed across the operating aisle on its way to the furnace. Firemen had stopped all openings with cleats and rags to make the firing room more comfortable at night.

Unless positive means are provided for maintaining proper fuel-air ratio, a starved furnace can cause much trouble where pulverized fuel is fired. The coal particle first emits its volatile matter, which burns rapidly. Remaining coke shell ignites only after the quantity of available oxygen has been decreased. Coke burns relatively slowly so that if there is an air deficiency it may be carried up in to the tubes of the first pass while still burning. A reducing atmosphere may result from this air deficiency, which may lower fusing point of ash, resulting in quickly coating the tubes of the first pass with slag, decreasing heat absorption and further cutting down draft. This condition is to be avoided wherever possible by providing proper air supply at all times.

What can be done about such cases of air deficiency? Furnaces must have anywhere from 12 to 16 lb of air per lb of coal burned, depending on the kind of coal. If the furnaces, or the forced-draft fans supplying them, take their air supply from the boiler room itself, an equal amount of fresh air must be admitted to the building from outside. In summer this may be highly desirable to reduce firing-aisle temperature. In winter, particularly in northern locations, entering cold air makes the firing floor nearly as cold as outside. This not only makes operators uncomfortable but may produce fog conditions around top of boiler room. Under these conditions, pipes without circulation have been known to freeze.

This situation can be remedied by a separate fresh-air supply direct from outside to furnaces or forced-draft fans, controlled so that outside air does not pass across the firing floor. If escaping gas or vapors make boiler-room ventilation necessary, an opening into the fresh-air duct from the room may be provided, with dampers to admit any

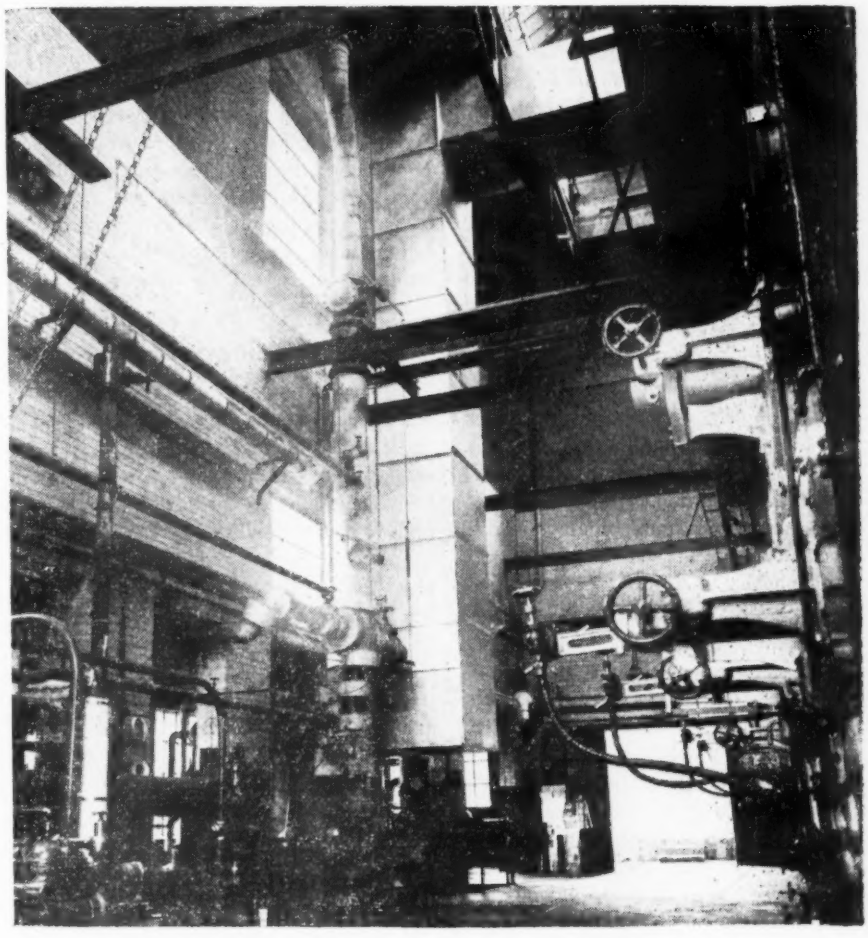


Fig. 1—Air duct in eastern industrial boiler room leads from heated area above to forced-draft fans at floor level. In addition to preventing drafts in the firing aisle, duct draws warmed air from above the boiler for combustion and saves fuel

desired part of furnace supply from inside. However, with attendant winter drafts and cold already described, outside fresh air must replace air taken from inside the boiler room.

A northern plant where winter temperatures are low found an interesting solution for such a situation. In this stoker-fired plant, which has an air preheater, the forced-draft fan above the boiler normally draws its air supply through a hooded duct from above the roof. The operators control a sliding section of this duct to take any desired portion of air from boiler room.

Heating and Ventilating

Boiler and turbine rooms and condenser basement require some heat, which is supplied by a duct taken from the hot-air supply leaving the preheater. Pipes deliver heated air to various cold points as needed, in the same proportion that the fans take from the boiler. This provides necessary heating and good ventilation.

This scheme also prevents sweating on steel work and fog formation in the boilerhouse, particularly around the coal bunker where the condition sometimes becomes aggravated by loading coal from outside at temperatures below zero. Similar arrangements are suggested for other plants where cold boiler aisles and sweating occur. Heating so obtained comes entirely from recovery of waste Btu in flue gas.

Another situation involving fresh-air supply may arise where the chimney projects only a short distance above the roof. Tests of chimney models in a wind tunnel, reported by Wolf and Von Hohenleiten* in "Wind Tunnel Tests To Establish Stack Height for Riverside Station," showed how flue gas disperses after leaving the chimney top. This dispersion, according to British tests, reaches the ground at a distance of about three times the chimney height. The wind-tunnel tests threw much light on this phenomenon.

If the wind blows at high velocity from the turbine-room side of the power plant, for instance, it tends to increase pressure on the windward side. For air masses to pass over the powerhouse, wind velocity must increase over the roof at the expense of reduced pressure in the same way that air flows over the airfoil of an airplane wing. When this high-velocity air leaves the leeward edge it aspirates air from below.

This entrained air must come from the surrounding area near ground level on the plant's leeward side. Such an air movement causes a flow toward the boiler-room wall similar to snow action downwind from a solid fence. This causes smoke or flue-gas plume from the chimney to be drawn rapidly downward and be caught in the backward eddy.

Any inert gas supplied the furnace lowers boiler efficiency because it cannot contribute to combustion and carries away heat in the flue gas as it leaves the boiler unit. Careful CO_2 checks of entering air reveal prevalence of flue gas dilution.

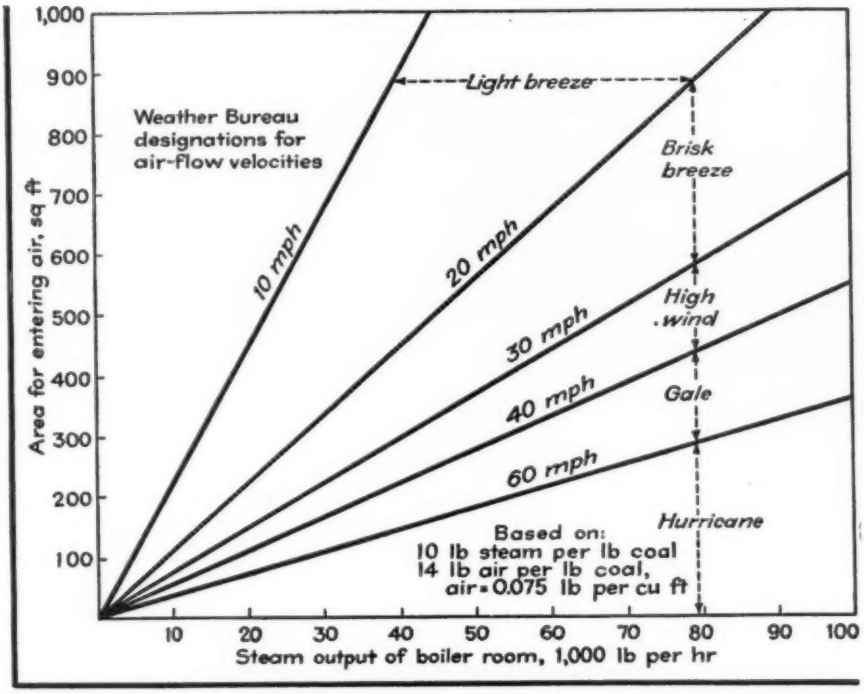


Fig. 2—Somewhere or other there must be sufficient entrance area into the boiler room to admit combustion air without generating a miniature gale near openings

Alternate Supply

The wind-tunnel tests show for each station design and location and for prevailing wind velocities there is a necessary chimney height above roof elevation to lift flue gas above the stream of high-velocity air passing over the roof. Since change in chimney height or arrangement is usually out of the question, an alternative measure against CO_2 dilution of air supply is to provide means of securing air from more than one side of the plant. With dual inlet arrangement, it is unnecessary to draw air from leeward during high winds.

A quite different situation arose in a large plant abroad where washers use cold river water to scrub flue gas. Under certain atmospheric conditions in winter with no wind, heavy low cloud banks hang over the plant. Cold river water reduces temperature of flue gas so greatly that it cannot rise through the cloud bank. Instead, being slightly colder than the atmosphere, flue gas spreads like an inverted mushroom to settle down over the neighborhood.

Resulting dilution of air supply to the furnaces results in poor combustion and even loss of boiler pressure. After analysis of the causes, however, the remedy here has been to shut off water to the washer long enough to allow hot gas to pass up the chimney. Hot gas penetrates the cloud bank and eliminates the difficulty.

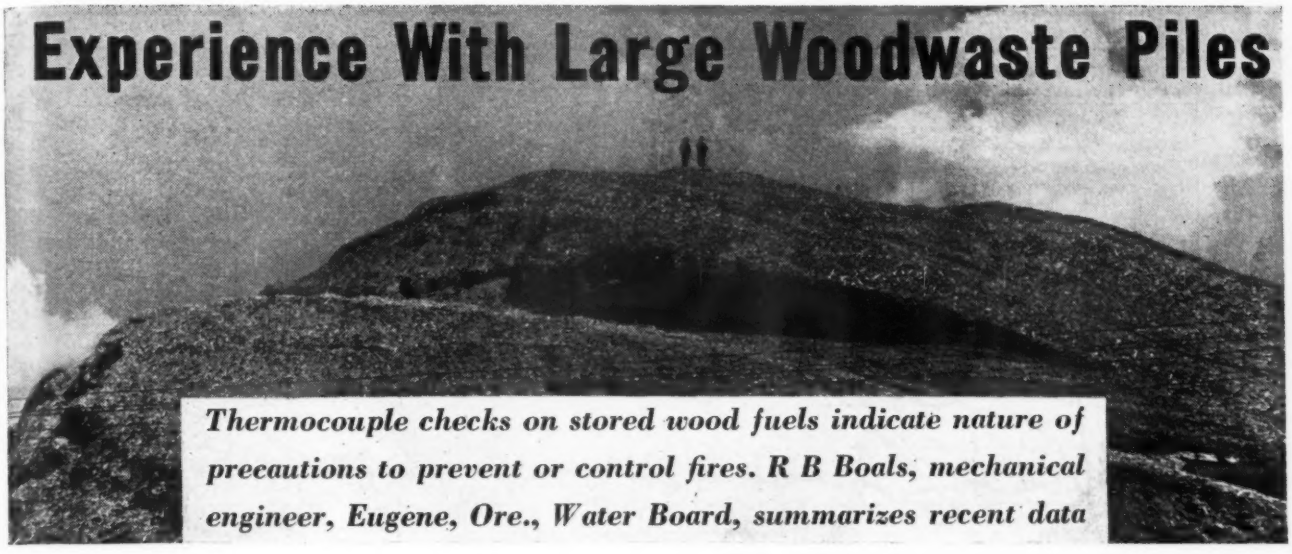
A similar condition occurred in a power plant on a river flood plain about a quarter mile wide where a 200-ft chimney is topped by rather steep banks rising more than 300 ft. Country on either side is comparatively flat and subject to high winds. Trouble was experienced frequently with lack of draft in the stoker furnaces. Investigation showed lack of draft when high winds prevailed above the bluffs.

Obviously, wind currents were being deflected downwards in passing over the river valley and the downward flow opposed the natural updraft of the chimney. The remedy was to replace the chimney with a new short stack with induced-draft fans. There is plenty of local air circulation in the lower levels of the valley to get rid of flue gas.

Insufficient air supply to furnaces is more prevalent in winter than many realize. Steps should be taken to correct such a condition as it leads to fuel waste, unforgivable in war time.

* ASME Transactions, October, 1942, page 671.

Experience With Large Woodwaste Piles



Thermocouple checks on stored wood fuels indicate nature of precautions to prevent or control fires. R B Boals, mechanical engineer, Eugene, Ore., Water Board, summarizes recent data

▶ FRESH GREEN SAWDUST and hog fuel begin to heat as soon as piled for storage. In small piles, temperatures rarely if ever approach a danger point, but where hundreds or thousands of 200-cu-ft units are stored outdoors hot spots appear and fires are common.

Northwestern Electric Co and Portland General Electric Co (Oregon) both accumulate piles containing more than 70,000 units (POWER, Nov 1939 and Feb 1940). As is to be expected, fires are frequent, particularly in the upper portions. Both companies burn the entire storage each year.

Since woodwaste fuel is a byproduct of the lumber industry, rate of production varies seasonally and total amount available depends on demand for lumber. Sawmill bins usually accommodate only about two days' run of wood waste and practically continuous removal is standard practice.

Eugene Water Board stores about 750 units of hog fuel and sawdust in a shed under cover. No fires have started in this shed in more than three years although temperatures up to 135 F, Fig. 1, are normal at the upper center of the pile. Depth varies from 20 to 45 ft. The Central Heating Co of Eugene also has stored sawdust under cover for many years without a fire or even seriously high temperatures.

Unusually heavy load demands of the past few years have required Water Board storage of additional hog fuel and sawdust in an outdoor area. Fuel is piled directly on the ground in an area about 125x300 ft and maximum quantity at any one time reached about 6000 units in the spring of 1944, with an average depth of about 32 ft.

When the bulk of the fuel was about 18 months old, smoke was observed at top-center. Since location and extent of the fire were uncertain, it was impracticable to move the burning material to the conveyors for immediate use.

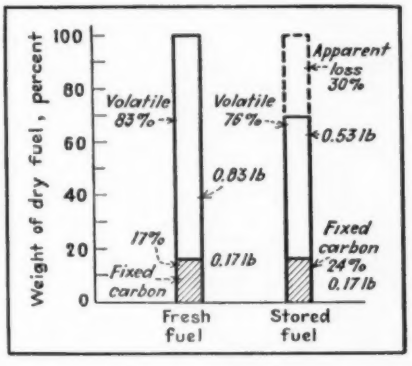


Fig. 2—Change in volatile content of stored fuel after about 18 months outdoors at about 160 F. Heating value per lb remains substantially constant

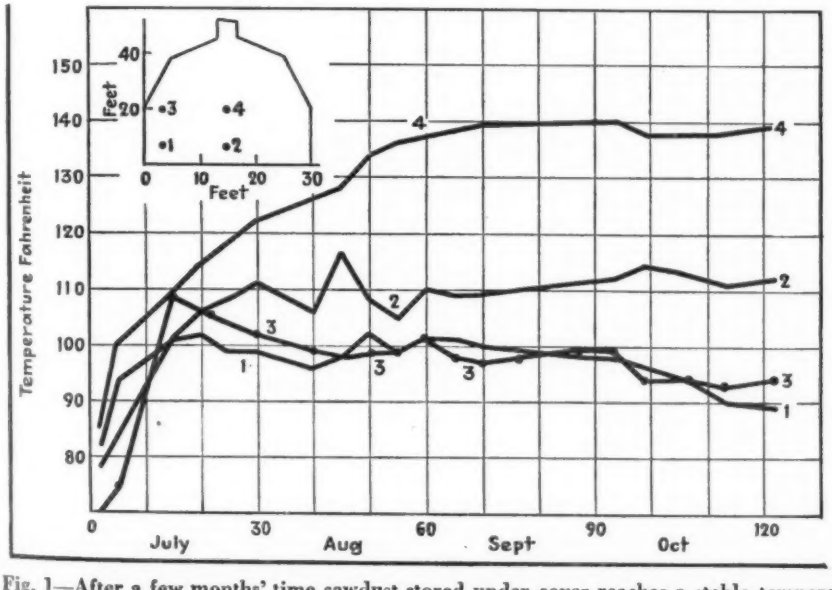


Fig. 1—After a few months' time sawdust stored under cover reaches a stable temperature. No fires have been experienced in this shed in more than three years

Both water and steam were applied. Water, of course, reduces value of adjacent fuel by increasing moisture content and also is less effective because it takes the shortest path to the base of the pile. Steam proved better because it has smothering value and can move in fire trails horizontally or rise vertically.

Fuel was not being consumed, but rather was being converted to charcoal at a temperature probably less than 1000 F. Charred residue filled substantially the same space as the original wood. The process did not progress at a very high rate so that

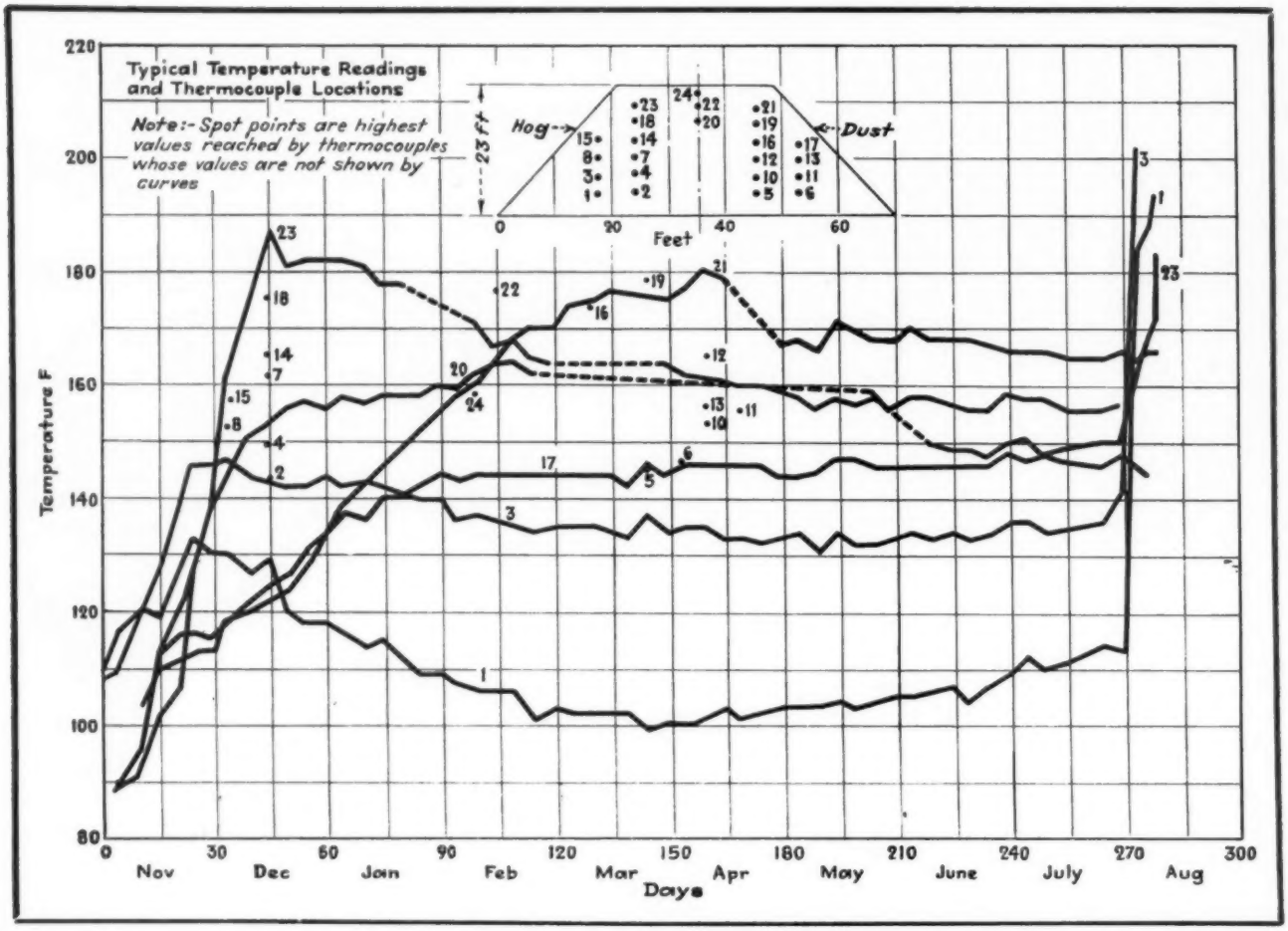


Fig. 3—Thermocouple temperatures at typical locations in test pile indicate rate of early heating greater for hog fuel than sawdust. Note rapid rise before fire started. Spot points indicate highest temperatures for other locations

smothering with steam and reasonably prompt removal of the affected material was a satisfactory method of dealing with the fire.

Woodwaste, subjected to temperatures ranging from 165 to 180 F for a considerable period, can be expected to contain about the same percentage of moisture as when stored but becomes dark in color and has a sharp, acrid odor resembling the fume from glacial acetic acid. Samples of original fuel and carbonized residue show a reduction in volatile content, Fig. 2, from 83 to 76% as determined by tests at Oregon State College. The difference in heating value per lb of dry fuel is insignificant. However, hot woodwaste is very corrosive to metals. A polished fork used to handle hot fuel will rust in only a few minutes.

To check rate of heating, conditions leading to fires, and to determine actual loss of weight in storage, a test pile was built, one side composed of 130 units of hog fuel and the other side 90 units of sawdust. Copper-constantan thermocouples were spaced 8 ft apart horizontally and 3 ft vertically. Samples

Fig. 4—Recovered sample bottle showing projecting cap of blackened fuel probably resulting from corrosion of metal screen covering bottle mouth

Fig. 5—One theory is advanced that fires start by chemical action between woodwaste and metal oxides, possibly at bolt near base of this post

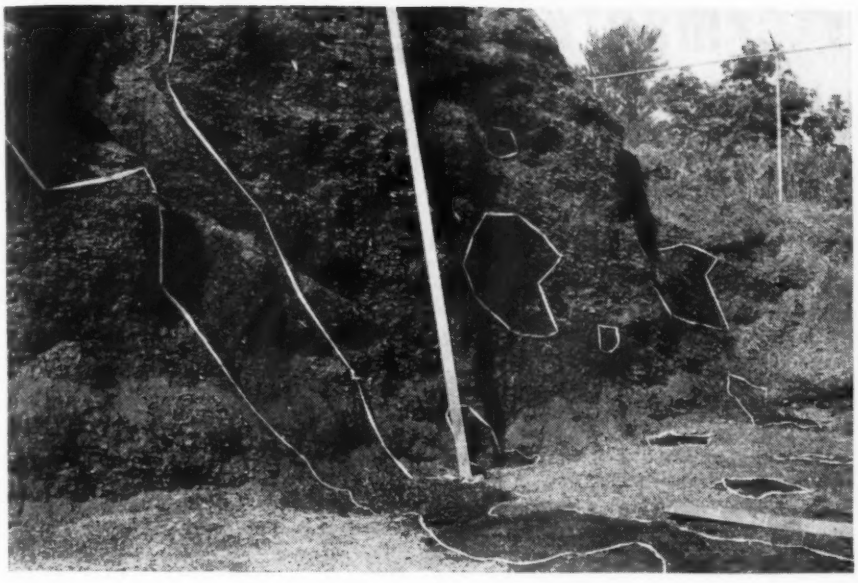


Fig. 6—White tape marks area of charcoal after most of pile was removed. About 4 in. of ground cover and exposed face of pile clearly show blackening effect

were taken from each thermocouple location for moisture and volatile determinations.

Part of each sample was placed in an ordinary milk bottle, Fig. 4, with the mouth covered by fine bronze gauze held in place with No. 14 bare copper wire. The gauze was intended to prevent loss of fuel from the bottle while permitting the contents to breathe and follow any other changes the ambient fuel might undergo. Bottles were buried at thermocouple locations.

Temperature readings, for a period of more than eight months, for typical thermocouples are plotted in Fig. 3. Hog fuel increased about 3 F per day until a maximum of about 190 F was reached, then succeeding temperatures were lower. Rise of sawdust approximated 1 F per day for a much longer time and maximum was not quite so high.

Unfortunately some of the couples failed and replacements in the upper portion of the pile were necessary. Disturbing the pile to insert new couples may have affected already stabilized temperatures.

After 270 days lower couples in the outer group of the hog-fuel section showed sharp rises and within a week smoke odors were noted. First actual fire occurred about 2 ft above ground in a pit left by removal of hog fuel from around a pole, Fig. 5, whose butt was buried in the slope of the pile. Smoke appeared thereafter at new locations every few days and removal of the test pile was begun.

In the meantime considerable quantities of water were used on the pile as hot spots appeared. Although the water was used sparingly, samples of fuel from the burned areas were of little value in determining cause of fire or its effect on adjacent fuel.

During removal of fuel, several cavities were found indicating access of air and actual burning of fuel. Air entrance was primarily due to action of the fire stream in cutting holes. Most burned sections, however, were packed with charcoal where apparently only carbonization had taken place. In almost all cases fuel was carbonized clear down to the dirt floor.

The fire and carbonization seem to travel in channels of comparatively small section at random through the pile. The reaction must take place under a near-equilibrium condition so that slight differences in fuel prevent or encourage further penetration. The carbonization can proceed many feet through the pile and still be confined to a small cross-section.

Where air does get in, the fire seems to find openings or cracks, probably caused by settling of the fuel, which allow hot gas to rise to the surface. Some caverns in the test pile were as much as three feet in diameter. One vertical chimney, Fig. 6, occurred at the boundary between the test pile and some older fuel, which had been in storage several months longer. This vent was about 17 ft high and had 4 sq ft or more of cross-section at some points.

Sixteen bottle samples were reclaimed intact. Others were broken by the bulldozer in moving the fuel or lost in burned areas. Many of the bronze screens and tie wires had been completely corroded away. Others were little affected by corrosion. Fig. 4 shows one bottle with a layer of almost black fuel covering the screen. The color is probably produced by the presence of metal or its corrosion products. Samples of fuel were taken near the bottles to see whether changes taking place were like those within the bottle.

Loss of original *dry* weight of fuel in the bottles ran from a minimum of 1% near the outer side of the dust

(*Continued on page* 142)

TESTS OF STORED FUEL

Eugene Water Board, Eugene, Oregon, 1944

Stored, location	Outside		Outside		Fresh	Fresh	Fresh	Inside
Months in storage	24	24	24	24	0	0	0	17
Kind of fuel	Mostly hogged		Mostly hogged		Dust	Dust	Hog	Mixed
Moisture, % of weight	54.0	55.6	57.2	58.2	45.9	45.7	47.7	30.4
Lb per unit* as fired	5510	5600	5500	5620	3660	3680	4520	3240
Lb dry wood per unit	2550	2390	2350	2310	1980	2000	2360	2250
Millions Btu per unit	19.3	17.8	17.3	16.8	15.8	15.9	18.6	19.0
Btu ratio, dust = 100	122	112	110	107	100	100	118	120
Btu ratio, hog = 100	103	95	93	91	85	85	100	102
Lb fuel burned, 1000's	88.2	172	330	190	95.6	195	130	119
Kwhr generated	9000	21,500	45,700	23,000	18,600	37,000	30,700	22,000
Average load, kw	1145	2250	4350	2420	1780	3550	3230	3070
Kwhr per unit**	912	865	852	882	841	800	1110	1026
Computed Data on the Basis of Fresh Hog Fuel = 100								
Kwhr per unit, %	82	78	77	79	76	72	100	93
Adj for Btu available, %	80	82	83	87	89	85	100	93
Adj for turb stm rate, %	107	90	80	93	104	83	100	92

* 200 cubic feet ** Except banking

How the Quartermaster Supplied Anzio Beachhead With Ice and Refrigeration

Major Douglas S Sterner tells how the Army assembled and installed individual pieces of equipment while protecting them against bombing and artillery fire. For instance, a 3000-gal covered tank of water for making ice stood on a mound in a sheltered spot

▶ NORMALLY THE ARMY transports ice by truck—by refrigerator vans when they are available—from a Base Section ice plant to the ration dumps. But at Anzio Beachhead all supplies had to be transported by ship, and frequently landed by "ducks." The time involved and the need for every square foot of storage space for absolutely essential items effectively eliminated the possibility of shipping ready-made ice.

During the early months this was not important but in late spring the hospitals needed ice urgently. Accordingly, the Fifth Army Quartermaster through the Engineers procured three gasoline-engine-driven one-ton portable ice plants and one sectional cold-storage warehouse. Under supervision of the Refrigeration Engineer of the Fifth Army Quartermaster's office, the 504th Engineer Regiment installed this equipment convenient to all hospitals that were in the same general vicinity.

Because the hospital area was often subjected to enemy bombing attack and artillery fire, an installation had to be designed to protect the machinery as much as possible. The three ice plants and cold-storage warehouse, which had sandbag-reinforced walls, were in a large excavation, one end of which was sloped and graveled so that a truck could back up directly to the warehouse for ice.

As protection against rain and sun, and to permit night blackout, a framework structure was built to support a tarpaulin roof and burlap sides. Burlap, which was used to permit air circulation, did not provide enough air on hot days so the side sections near the compressors were hinged. Raising them during the day permitted free air circulation, whereas lowering them at night when the temperature outside fell many degrees did not affect compressor operation. Exhaust lines from the gasoline engines were carried outside to eliminate fumes and remove heat.

Fig. 1—Portable ice plant and cold-storage rooms used by the Fifth Army Quartermasters at Anzio Beachhead. Each unit has a capacity of one ton *Signal Corps photo*

Equipment was arranged for easy operation, convenient to the cold-storage warehouse. Two of the plants were lined up so that the ice-freezing ends were together, with a dip tank, ice-removal platform and slide between that both plants could use. Above them and over the center a monorail hoist facilitated removal of the ice cans. The third plant had its own dip tank.

Over-all arrangement was such that all three plants were convenient to the cold-storage warehouse where ice was stored until issued. The warehouse did double duty by storing blood and biologicals.

A 3000-gal covered canvas water-storage tank on a dirt mound behind the installation had sufficient elevation to permit filling ice cans by gravity flow through a hose equipped with a quick-closing nozzle. Tank was filled from a water truck that could pump directly into it through a hose.

Designed for and used by the hospitals only, the installation was of incalculable value especially during the days of the great breakout from Anzio.

In a field army, handling perishable items is normally more a problem of supply than of storage. Usual procedure is to haul them direct to Army truckheads from a Base Section in the rear.

Generally hauls of any distance between ships and cold-storage plants are made with refrigerator vans of a Quartermaster Mobile Refrigeration Co. Similar units may be assigned the Army to haul perishables from cold-storage plants to Army ration dumps where issues are made directly from the vans.

It is often desirable to take care of *hold-over* perishables, which are drawn but, generally because of a tactical change, not issued. Such was the case at Anzio where a sectional cold-storage warehouse was installed in the ration dump. This unit also was protected against everything but a direct hit by locating it in an excavation and sandbagging as in the hospital installation.

The Fifth Army Quartermaster frequently acts as advance agent for the Base Section by checking and inspecting cold-storage facilities in newly liberated cities. When suitable plants are found that can be operated without extensive mechanical repairs the Fifth Army Quartermaster requisitions them and, through the Refrigeration Officer, starts immediately to get them into operating condition. In Rome, two such plants were located, requisitioned and put in operation. In the first, the Fifth Army Quartermaster refrigerated and stored meat until the Base Section could send the necessary personnel to operate the plants.

Under unusual conditions, the Fifth Army Quartermaster found it desirable to take over operation in Cecina of a cold-storage plant of about 125-tons storage capacity. The plant was used for about two months because its advantageous position appreciably reduced time and work in handling perishable supplies.

A survey of cold-storage facilities in Florence located three usable plants. They were studied, their materials requirements obtained and storage capacities calculated. After obtaining sufficient assurance that the plants could operate without great mechanical difficulties, Base Section was informed and requested to supply operating personnel if it needed the facilities.

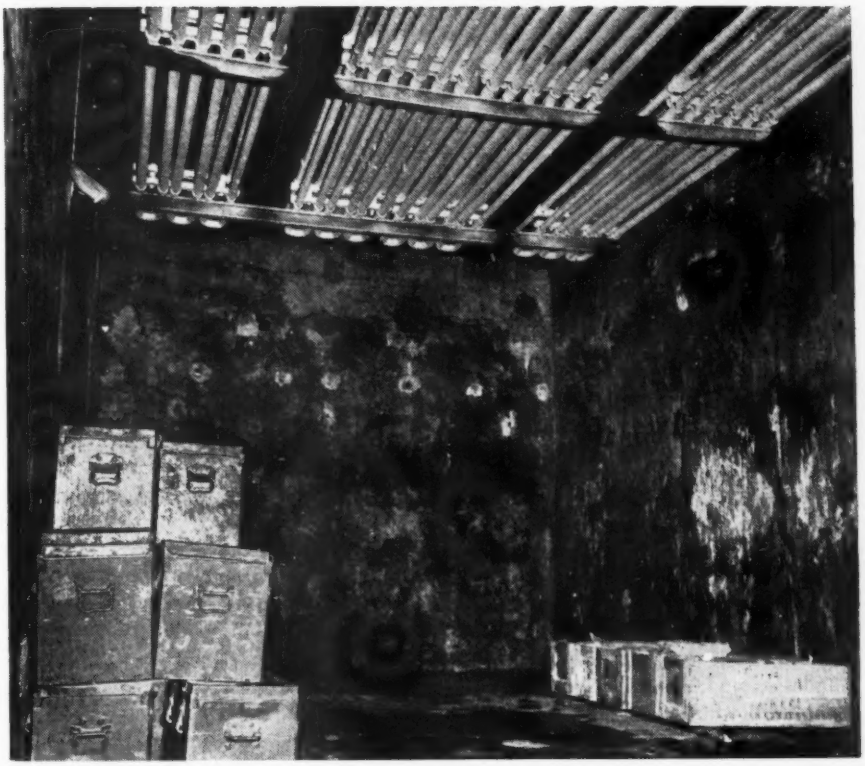


Fig. 2—Interior of cold-storage room used by the Fifth Army in Italy for storing perishable supplies. All cooling coils hang from the ceiling *Signal Corps photo*

If bombing, shelling or demolition have not destroyed a plant, four major items are needed to put it in operation. One is an adequate power supply, which usually presents a serious problem because the enemy almost always destroys power plants. This has been especially true in Italy. Also of great importance is an adequate supply of anhydrous ammonia, non-freezing oil and lubricating oil. Of these, non-freezing oil has presented the greatest problem because it is not a stock item with the Army and a local supply of it is almost nonexistent.

Ammonia has been a difficult item to obtain occasionally. Once it was necessary to search over a large area until a few cylinders were discovered in the ruins of a destroyed industrial plant. Many minor items have been required from time to time. They range from ammonia gas masks to extra-heavy piping, and include coal, solder, welding equipment, oxygen, acetylene, asbestos gasketing material and belting materials. Generally they can be obtained from Quartermaster, Engineer or Ordnance Depots. Often temporary substitutes have to be used until supplies of the proper kind arrive.

The Army's refrigeration problems are, in addition to distribution by means of refrigerator van, the location, requisition and putting into operation of cold-storage facilities in cities. This is primarily a rehabilitation problem and as such requires considerable effort to obtain the necessary materials so that civilian operating engineers will have tools and parts to repair plants and put them in operation for Army or Base Section.

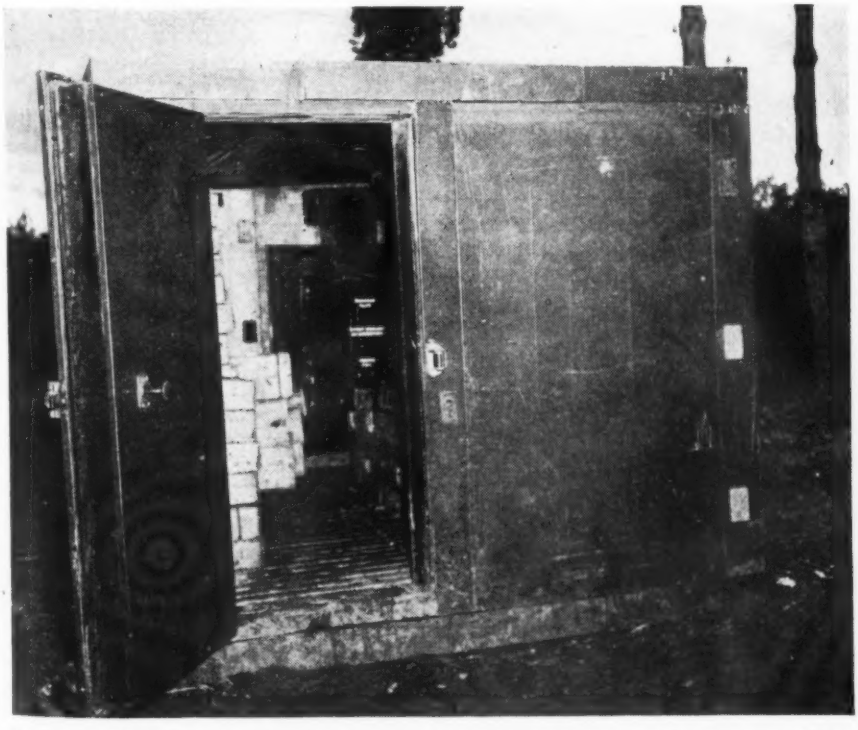


Fig. 3—Cold-storage warehouse that provided storage for ice and other perishable supplies. Sectional construction facilitated transportation *Signal Corps photo*

Locking Foundations To the Floor Prevents Machine Vibration

Bonding a reciprocating machine's foundation to the floor increases its reaction to unbalanced forces. Effect is the same as making the foundation thinner and increasing its length to better distribute the dead and dynamic loads, says I A Butcher

► OPINIONS DIFFER on the best way to design foundations for compressors and other reciprocating machinery. Some engineers leave a space between the foundation and adjoining concrete floor to be filled with mastic or other elastic material. Others pour the floor concrete tight against the foundation, claiming that a compressor with its foundation tightly locked in by the concrete vibrates less and operates more smoothly than one that is not restricted.

An analysis of the two methods, *A* and *B* in the sketch, shows why the shallow foundation vibrates less than the deeper one when both contain the same volume of concrete. Foundation *A* is 8 ft long while *B* is 16 ft. Both are 3 ft wide. *A* is twice as thick as *B*. Since the machine is assumed to weigh 4000 lb and the foundation 21,600 lb, total load is 25,600 lb. In *A* the center of gravity is 2.4 ft below the foundation top while in *B* it is only 1.1 ft below.

Vibration of a foundation and its machine is resisted by inertia of the mass, also by its support—in this case the ground supporting the foundation. In *A*, ground loading is 1065 lb per sq ft, while in *B*, it is 532.5 lb per sq ft.

Downward Component

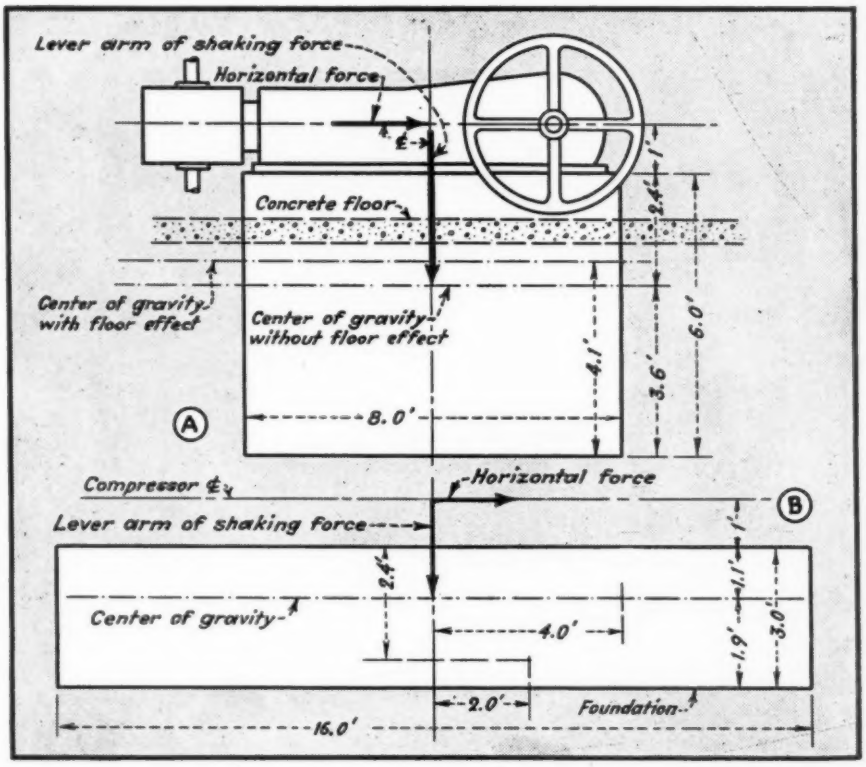
The vertical component of a compressor's unbalanced forces acts downward near the crankshaft, thus tending to rotate the machine and foundation. The longer the foundation, the less the rotating effect with a given machine and a given force. The horizontal component of the unbalanced forces acts through the machine's center: 3.4 ft above the center of gravity in *A* and 2.1 ft above the center of gravity in *B*.

When a foundation vibrates it generally does so by rocking about its center of gravity, which means that the pressure at the foundation foot alternates from maximum to minimum at each end, with minimum variation at the center. Assuming that the foundations in *A* and *B* tend to rock about their center lines, resistance to this rocking would be twice as great in *B* as in *A*. Also, the rocking effect of the horizontal component of the unbalanced force is directly proportional to its distance above the unit's center of gravity. Thus the effect of this force would be only 21/34 as great in *B* as in *A* if the foundation were the same length.

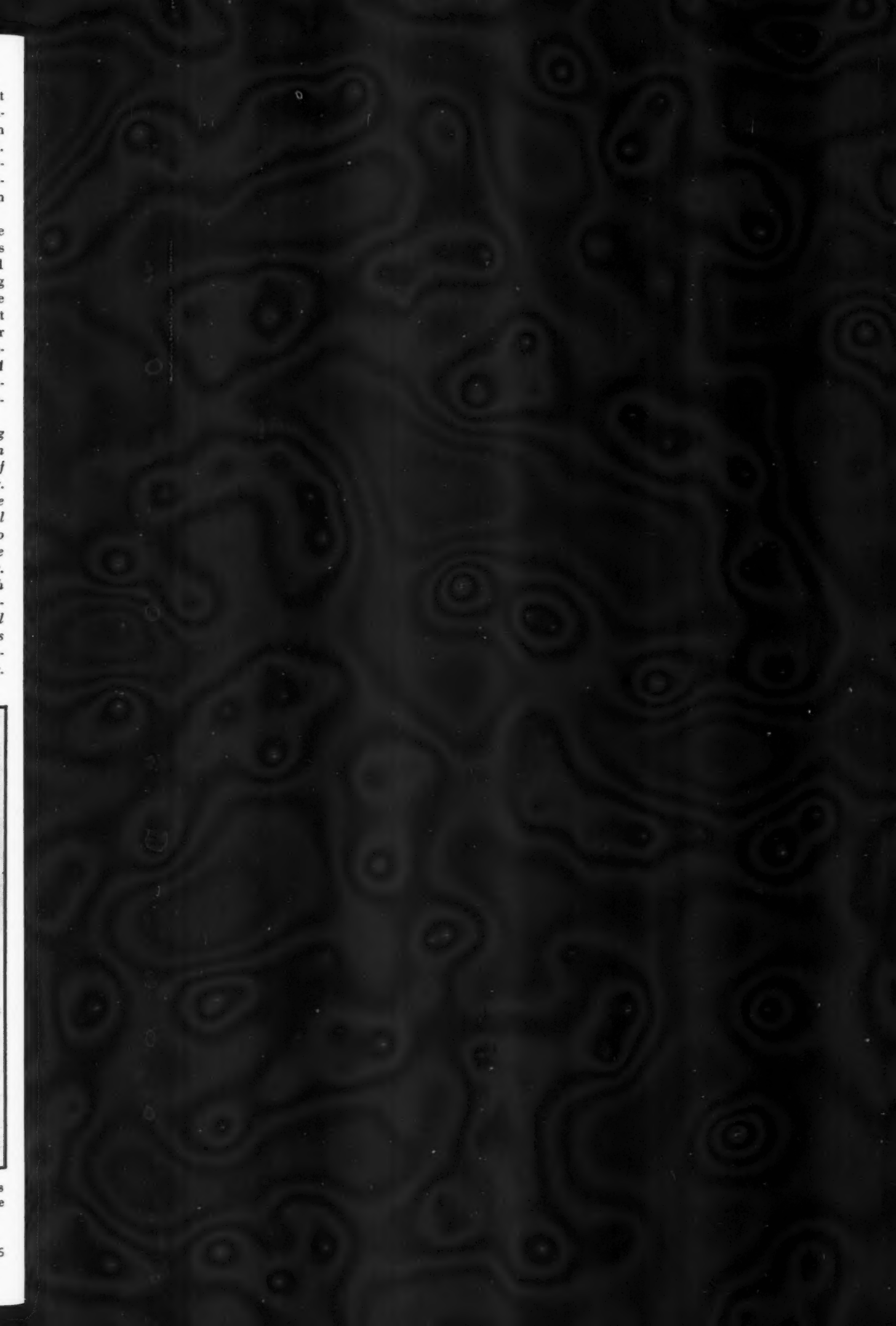
However they are not of equal length, so if this rocking force acts vertically through the center of gravity at a point half way between the foundation's center and end, the point of application in *B* is twice as far from the center as *A*. Thus the real effect of the changed design is to reduce the horizontal component's effect further by ½ or from 21/34 to 21/68 of the effect in *A*.

To consider the floor (6 ft outside the foundation) as part of the mass raises the center of gravity from 3.6 to 4.1 ft above the foundation bottom. Fitting a concrete floor tightly to a machine foundation increases its reaction against unbalanced forces in a manner similar to increasing its horizontal area and decreasing its depth. Proportions in *A* and *B* were selected to indicate the general effect of making the center of gravity low or high.

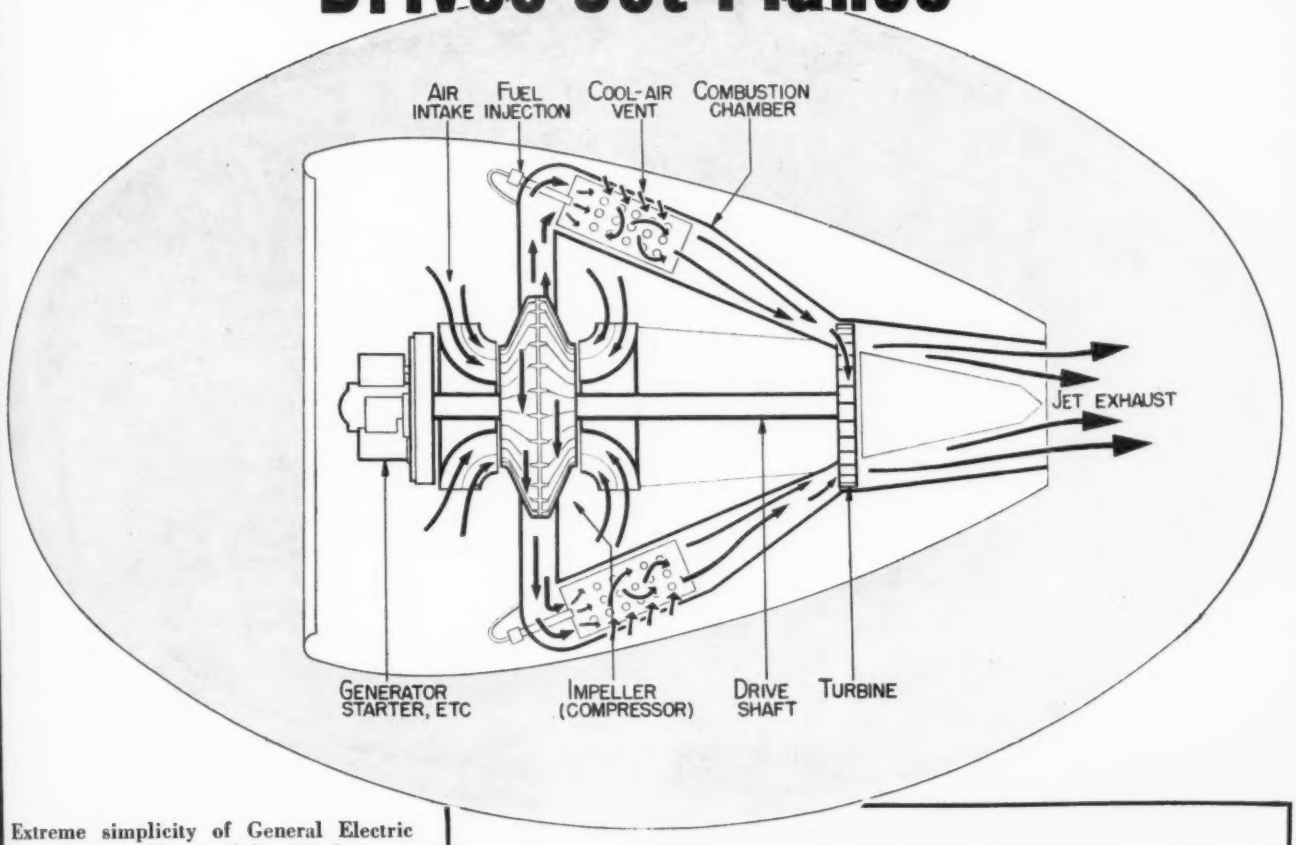
Editor's note: Tying the surrounding floor to a machine foundation is often prohibited because of the danger of transmitting vibration to the building. General practice shows that if the foundation is large enough to encase all foundation bolts and deep enough to rest on solid ground below frost line the machine will operate satisfactorily. Load carrying ability of the soil which supports the foundation has considerable bearing on whether a machine will operate smoothly. For heavy machines this may require driving piles or excavating to set foundation on bed rock.



Effect of horizontal component of the unbalanced force is directly proportional to its distance above the unit's center of gravity. *A* tends to rock more than *B* because the lever arm of the shaking force in *A* is longer than that in foundation *B*



Gas-Turbine Compressor Set Drives Jet Planes



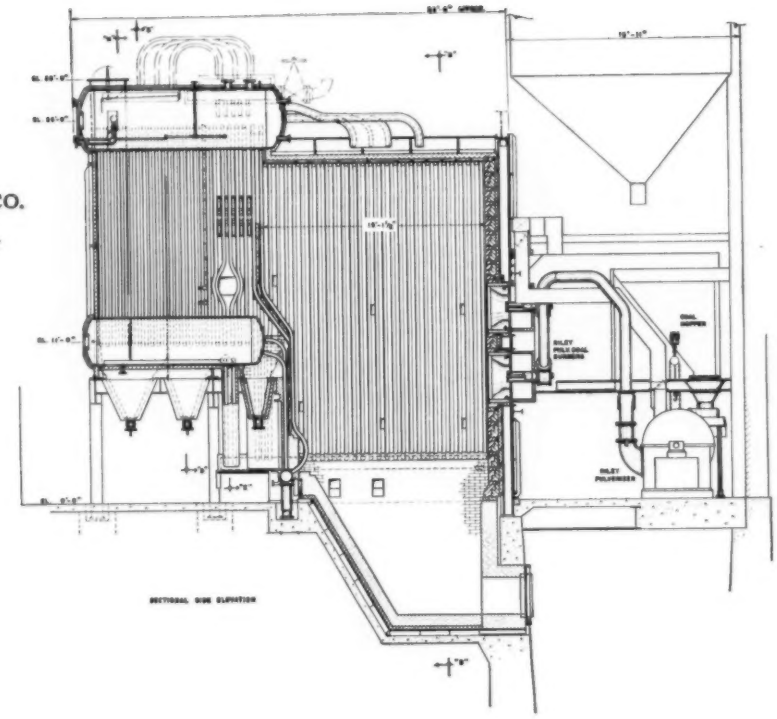
Extreme simplicity of General Electric jet engine is illustrated by this diagrammatic sketch. Compressor, driven by single-stage turbine, supplies air to multiple combustion chambers

▶Air comes in the front end, goes through the compressors, burns with kerosene, drives a single-stage turbine and jets through the tailpiece at high velocity. That's all there is to jet propulsion, no propeller, no cooling system, no superchargers. The jet engine has only a tenth as many moving parts as the usual aviation engine. Eleven ordinary bolts hold it in place. Four mechanics can pull both engines of a fighter plane and replace them with new ones in a day.

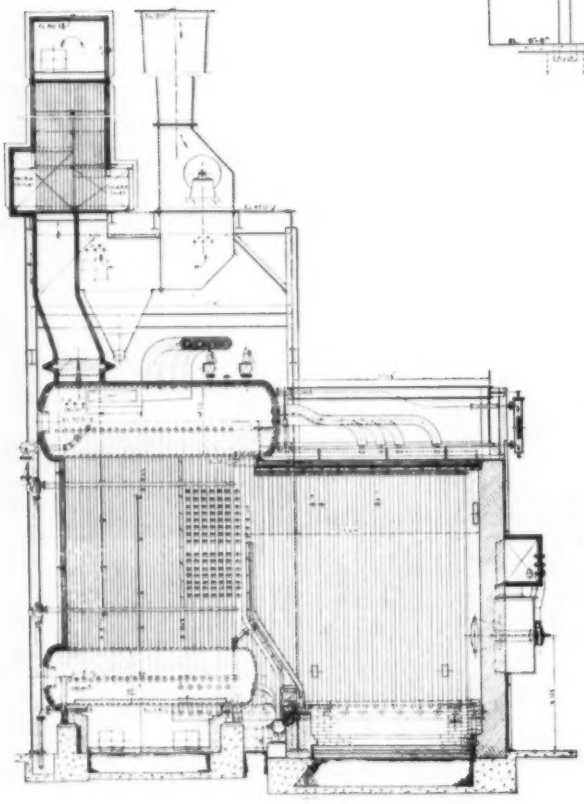
Jet engines need no warming up—a minute after the starter button has been pressed the pilot can take off. The single high-speed rotor comes up to temperature in a few seconds and cools off on return to base more quickly than the air-cooled radial gasoline engine.

Super-velocity jet of hot gas emerging from tail opening produces force sufficient to speed plane faster than propellers at high altitudes

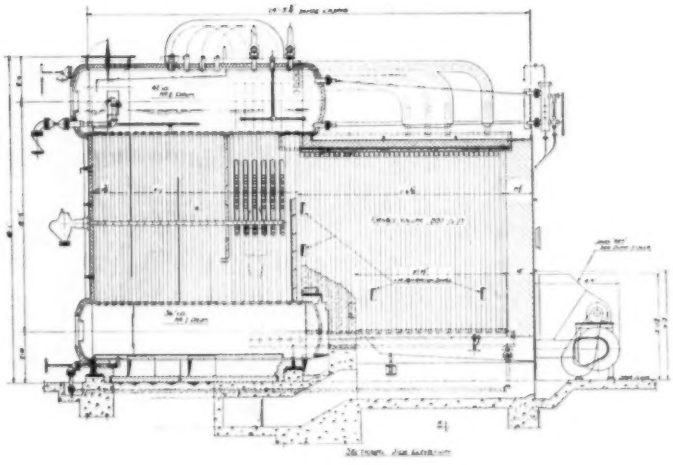
Efficient Boiler Units



AMERICAN HOIST & DERRICK CO.
40,000 lbs./hr. Riley "RO" Boiler
Fired by Riley Pulverizer and Burner
Efficiency—81.5%



GENERAL ANILINE WORKS
40,000 lbs./hr. Riley "RO" Boiler, Oil Fired
Unit equipped with Riley Air Heater
Efficiency—85%



NORRISTOWN MAGNESIA & ASBESTOS CO.
25,000 lbs./hr. Riley "RO" Boiler
Fired by Riley Side Dump Stoker
Efficiency—78.5%

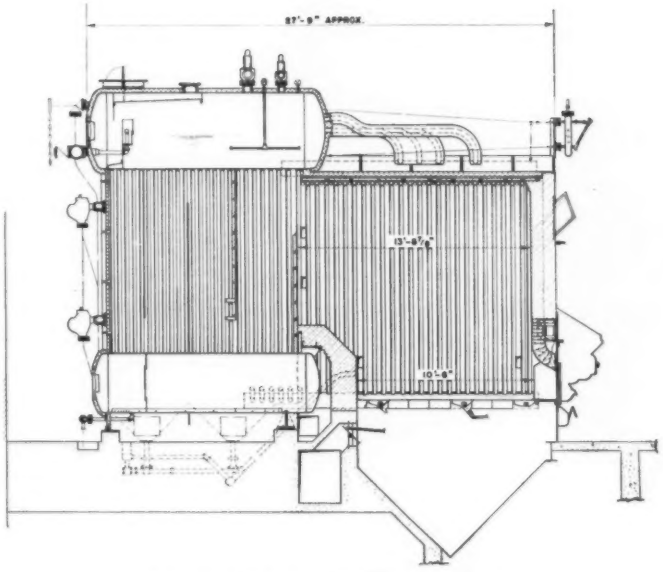
RILEY

STOKER CORPORATION, WORCESTER, MASS.

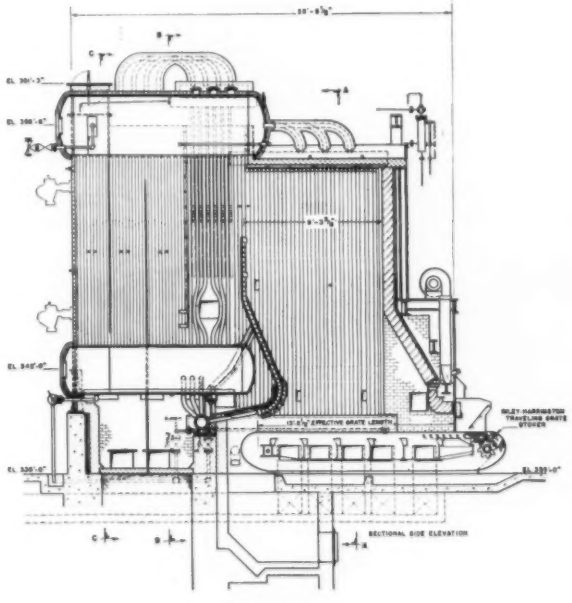
Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

t will pay you to visit modern Riley Installations

for the smaller plant



REILLY TAR & CHEMICAL CO.
40,000 lbs./hr. Riley "RO" Boiler
Fired by Spreader Stoker



CITY OF METROPOLIS, ILL.
25,000 lbs./hr. Riley "RO" Boiler
Fired by Riley-Harrington Traveling Grate Stoker
Efficiency—76.1%

Due to their efficient and trouble-free operation, Riley "RO" Boiler units have been generally accepted as one of the best buys in the smaller boiler field. As illustrated, any type of firing can be used.

These units embody many of the design features formerly found only in large steam generating units—water-cooled furnaces, steel clad insulated settings and an integral economizer.

A Riley engineer will gladly discuss the economics of installing Riley "RO" Boilers in your plant, without obligating you in any way.

A few of the well-known users of Riley "RO" Boiler Units

General Electric Co.	Pet Milk Co.
American Brass Co.	Isaacson Iron Works
Goodyear Tire & Rubber Co.	C. G. Conn Co.
Hercules Powder Co.	Pepsi-Cola Co.
Revere Copper & Brass Co.	Packard Motor Car Co.
Monsanto Chemical Co.	Mead Corporation
Nicholson File Co.	Nunn Bush Shoe Co.
American Steel & Wire Co.	A. C. Lawrence Leather Co.
Perfect Circle Co.	Republic Creosoting Co.
Battle Creek Gas Co.	Scovill Mfg. Co.
Modine Mfg. Co.	A. O. Smith Co.
Starline, Inc.	U. S. Gypsum Co.
Park & Tilford, Inc.	Wickwire Spencer Steel Co.
General Aniline Works	Belding-Heminway Co.
Aluminum Industries	J. Wiss & Sons
Eagle Picher Lead Co.	Behr-Manning Co.
Pennsylvania Salt Co.	Bullard Co.
Heyden Chemical Co.	Curtiss-Wright Corp.
Armour & Co.	Standard Oil Co. of Calif.

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Electronic Fence Keeps Fish Out of Power Canal

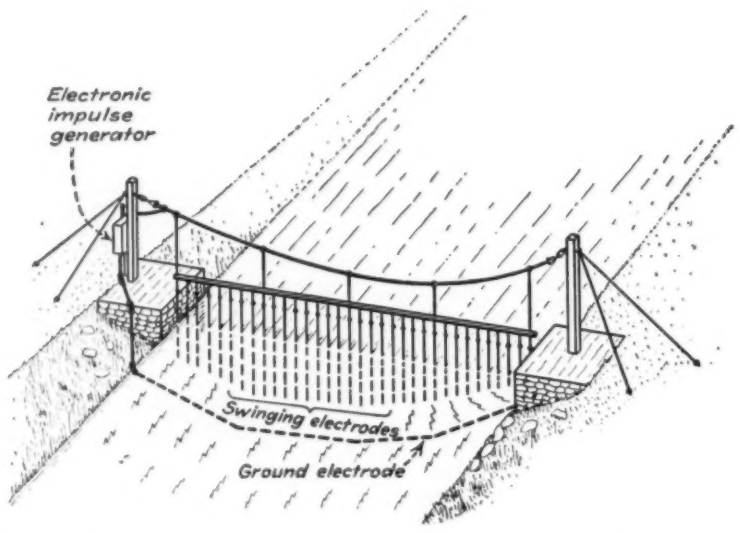

Fig. 1—Standard arrangement of electric fish screen. Swinging electrodes do not touch bottom. Debris passes freely while fish are turned back by harmless impulses from a small-power electronic generator

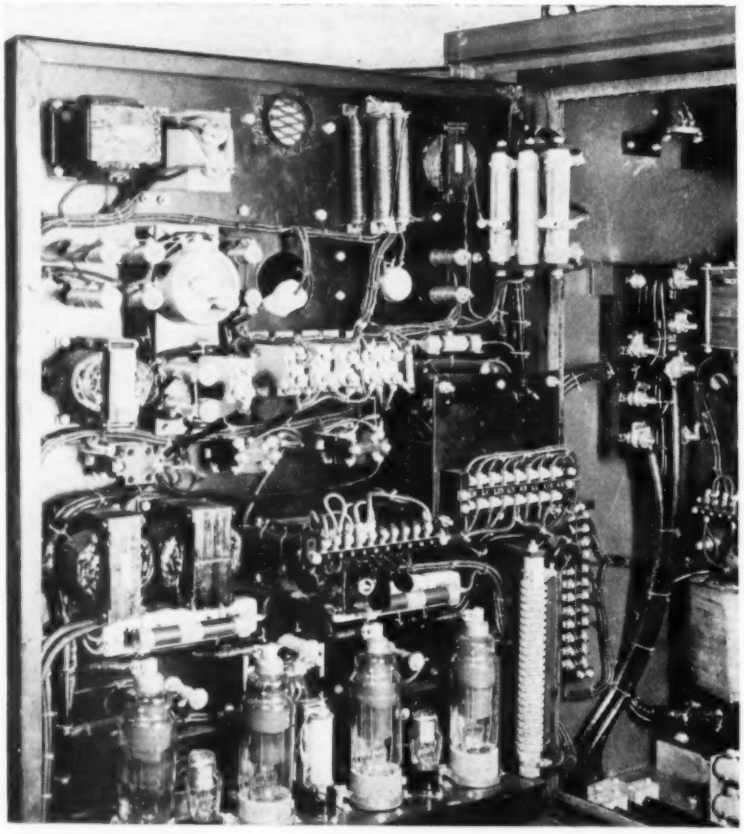

Fig. 2—Typical electronic-impulse generator takes small power input from lighting outlet, small lighting set or small waterwheel generator

▶ SAVING FISH for fishermen is a new job for electric power on the system of the Sierra Pacific Power Company. A recently installed electric screen at the canal inlet keeps all fish out of the canal that supplies 500 cfs of water to the Farad hydroelectric plant, which is located on the Truckee River, near Floriston, California.

According to T J Welsh, assistant engineer of Sierra Pacific, this electronic snubber for gate-crashing fish replaces a far more expensive fixed-bar mechanical screen installed in 1931 to keep fish out of the canal. The bar screen did that, but put operators to a lot of trouble clearing off trash and ice to maintain flow of water to the plant.

Equipped with free swinging electrodes reaching part way to the bottom, the electric screen offers free passage to debris. Fig. 1 shows the typical arrangement of electrodes. It should be noted, however, that the Farad installation does not make use of the catenary cable suspension that is pictured in Fig. 1, but suspends the swinging electrodes from the wood framework, which was originally installed to support the mechanical screen.

Impulses Harmless to Fish

Electronic impulses passing from swinging electrodes to ground electrode create an electrified zone through which fish will not swim. However it is claimed that the electrical impulses cannot harm the fish, even to the extent of temporarily gripping the swimming muscles. This last is important because fish made temporarily helpless by so-called "physiological tetanus" would be swept through the screen by the flow of water.

Inventor and patentee of the system is Henry T Burkey, electrical engineer, Hollywood, Calif., who has spent many years devising an electric barrier that will stop fish without permanent injury or temporary paralysis.

Advantages claimed for the Farad installation include low first cost, low operating and maintenance cost and the salvage of 35,000 lb. of steel from the old screens. The station operator two miles away checks operation of the electric screen by lifting the telephone receiver (company circuit) and listening for the periodic sounds made by the impulse generator.

The electric screen can be installed ahead of head gates or other intakes. It can also be used to confine fish in lakes, reservoirs and private ponds—to divert upstream migrants to "fish ladders"—to keep fish out of water mains and away from chemical plants.

SUSTAINED CONSTRUCTION ACTIVITY

One Step Toward High Level Employment

IN the 34th editorial of this series, it was pointed out that sustained prosperity, based on high level employment, was a major postwar goal accepted by government, management and labor.

That editorial developed the theme that, if the goal were to be approached without undue sacrifice of our essential liberties, we must forego the search for magic panaceas, and follow the harder but more promising course of analyzing step by step, and industry by industry, the measures that might contribute toward the end sought.

This is the first of a number of editorials following such a particularized approach. It will examine the role of the construction industry in forwarding sustained prosperity.

☆ ☆ ☆

The influence of construction upon the general level of economic activity is important but not decisive. The claim is frequently advanced that major fluctuations of the business cycle might be ironed out by a properly devised and timed public works program; but any examination of the relatively modest contribution of construction activities to total national output will demonstrate its extravagance.

In the twenty years from 1920 through 1939, the value of new construction averaged just over 8½% of the gross national product. If we add repair and maintenance expenditures, the total is increased to a little over 12% of the gross product. But approximately two thirds of the construction of this period was privately initiated, and only one third was represented by government construction, federal, state and local combined. To expect that we can level out the peaks and valleys of our whole economy through manipulating the 4% portion that is represented by government construction is to expect a very small tail to wag a very large dog.

In fact, the record of construction activity in the past has been on the side of disequilibrium rather than stabilization. In boom times construction activity has climbed to relatively higher peaks than those reached by the economy as a whole; in depression periods it has fallen to deeper troughs. Aside from the special work relief program of the depression thirties, the performance of public construction in this respect is little better than that of private. New government construction mounted with the general trend of the boom from 1921 to 1929, thereby adding its weight to the inflationary trend.

Instead, then, of expecting the construction industry to stabilize our whole economy—a task clearly beyond its power—it would seem appropriate to ask that it look to the more attainable goal of leveling out its own violent fluctuations. If this can be done, many of the most vexing problems of the construction field and of its sphere of influence will be mitigated, employment will be regularized in one important segment of industry where the past record has been particularly uneven, and one aggravating contribution to general business instability will be removed.

The achievement of these highly important, if limited, aims will require the thoughtful, vigorous, and concerted cooperation of management and labor in the construction industry, of a variety of governmental agencies, and of those who direct the sources of construction credit. Of the many measures that must be woven into an ordered program, it is practicable here to present only the broad outline of those which seem to offer the greatest potential usefulness.

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1. Stabilization implies the holding of a balance rather than a freezing at a given level. No rigid formula for a most desirable level of construction activity is possible or desirable. However, it may be accepted as a reasonable initial premise, that we could sustain in the future without major distortion something like the 12% ratio of total construction to gross national product that has been approximated in the past. If it is to serve as an useful reference point, such a generalized premise must be subjected to constant testing both nationally and locally. There must be careful and continuous scrutiny for signs of demand saturation, cost inflation, and labor shortages, all danger signals of far greater reliability than any percentage formula.

The first requisite then is the general availability of information along such lines, far more complete and current than has hitherto been at hand. The second is a general will to hold building activity at a level as high as but not higher than we probably can sustain. Once this principle is accepted, the problem becomes one of marshalling all available instrumentalities to forward it.

2. Public construction, although too small to exert a decisive influence upon economic activity as a whole, can

condition construction trends to a major degree. If, in the decade following the war, government construction approximates its 1920 to 1940 average of one third of all construction, its properly timed impact could do much to level out the construction cycle.

To do this most effectively, public construction should be deferred where and when private building is going forward at a satisfactory pace, and should be started when and where private activity shows undue slack. All government construction does not lend itself to such adjustment. But a large portion of it could be held up for the three to five years which, upon past experience, would provide the necessary leeway to counteract the more violent fluctuations in private building.

Such a program presents numerous difficulties both political and administrative. None should be insurmountable, and the results promise to be of sufficient moment to justify the extraordinary effort that would be required to coordinate federal, state and local government programs. Here is an excellent forum for testing whether or not government economic activity can be made to supplement rather than supplant private effort to serve ends upon which all are agreed.

3. Since private building, postwar as in the past, must supply the preponderant share of construction activity and employment, costs will continue to play a dominant role in determining levels of operation. Wartime restrictions have created formidable backlogs of deferred demand for most types of private, and for many of public, construction. Such demand is so great that it almost certainly will provide the impetus for a postwar building boom of several years duration. There is considerable doubt that in the beginning our building trades, dislocated by war and at low ebb, can organize rapidly enough to carry their share of the anticipated general advance.

However, if former patterns hold, building activity, after a lagging start, will soar, costs will mount, and eventually will saturate effective demand with resultant collapse. That, of course, is precisely the sort of a situation we are seeking to avoid. Crucial to this end is the prevention of rising costs or, better still, the reduction of building costs from present swollen levels.

A recent study by technicians of the War Production Board on the outlook for private housing construction illustrates the point. From 1900 to 1940 the number of housing units built in this country closely matched the statistics of new family formation. The former ran considerably ahead of the latter from 1920 to 1929, and fell behind by the same margin in the following decade.

If the market for new houses were to be similarly limited for the period from 1940 through 1949, the effective demand for new housing during the last five years (1945-1949) is estimated at 3,000,000 units. That is after allowing for houses built from 1940 through 1944, and for vacancies, demolitions, and other factors. If, however, prices could be reduced to 1939 levels, the 3,000,000 unit demand is estimated as increasing to more than 7,000,000 units. Since the latter figure is substantially beyond our production capacity for the period, a backlog would be created that would support an effective sustained demand for the subsequent decade (1950-1959) of 1,000,000 units per year, as against half that amount if rents and sales prices mount with increasing incomes.

The precise accuracy of such an estimate may well be questioned. There can be no question as to the general validity of the point illustrated. The progressive lowering of construction costs will stimulate demand in this field as it has in others. Building management, labor, and their suppliers and customers stand to gain from such a result. Unnecessary restrictions against the adoption of improved technologies and increased productivity should, therefore, be removed, whether imposed by codes of government, regulations of unions, collusion of managements, or inertia of workers. Unless there are compelling social justifications such restrictions must be judged harmful to the whole economy.

4. Numerous other measures could contribute substantially to increased and increasingly stable construction activities. Space remains only to stress the importance of careful consideration for the use of credit facilities as a means of stabilization. In recent years the establishment of the Federal Housing Administration provided a needed stimulus to mortgage lending in the field of housing. The modern pattern of long-term mortgages, providing for regular amortization as well as interest, should be a steadying factor in periods of liquidation. However, there appear to be further possibilities for using credit facilities as a brake when construction activity threatens to climb beyond a level that can be sustained. If public and private lending agencies could devise sound means for raising mortgage rates, increasing down-payment requirements, shortening amortization periods and basing value appraisals upon normal rather than inflated costs, they might exert a healthy influence against the tendency of the construction bubble to inflate until it bursts.

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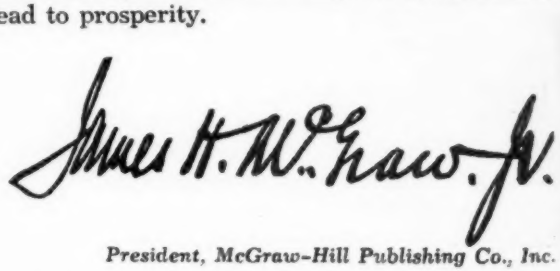
There is no royal road to sustained high level employment. There is not even a single path to assured construction stability—there are many paths, all strait and narrow and all paved with bruising cobbles. This is true for all other major segments of industry.

It is easier to seize upon a magic formula such as monetary control, or deficit spending, or any one of a score of others, than to undertake an intricate task of piecemeal exploration. But only the latter course will lead to prosperity.



President, McGraw-Hill Publishing Co., Inc.

Additives in Lubricating Oils Improve Their Characteristics

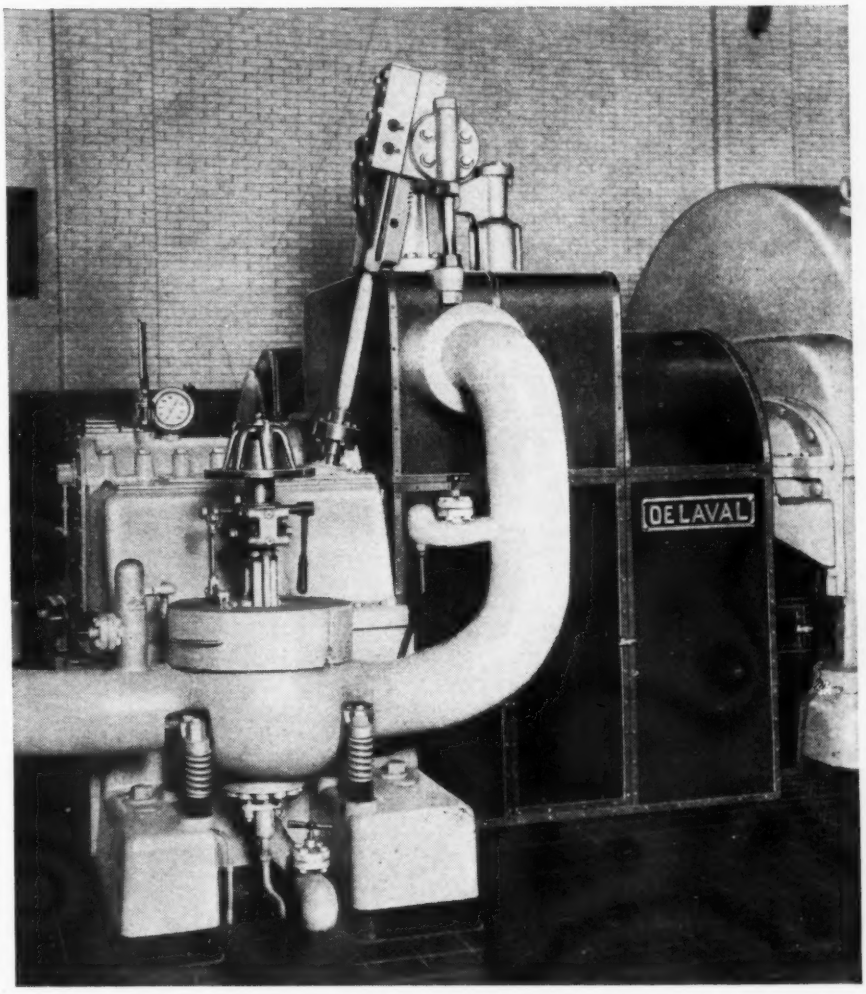
What are additives? Why are they used, and what are they supposed to do? A J Strohmaier, chief lubrication engineer, Joseph E Seagram & Sons, gives the answers and tells how these agents improve the seven characteristics that all good lubricating oils must possess. A word of caution is included on the use of lubricating oils that contain one or more additives

▶ We hear a lot about the new additive-type oils, yet it is surprising how little about them many engineers know. We are almost made to believe that adding chemicals, etc, to lubricating oils is a new and revolutionary science. Granting that we have only scratched the surface of this phase of lubrication, nevertheless lubricating oils have been compounded with various agents ever since petroleum lubricants were introduced over 75 years ago.

At that time, petroleum lubricants were eyed with suspicion and frequently used to dilute the currently accepted and more expensive animal and vegetable oils rather than to improve their quality. But it was found that the proportion of older oils in the new could be reduced appreciably without adversely affecting their lubricating qualities. For many purposes, the older oils were soon eliminated. Modern steam-cylinder oils with their 1 to 5% of compound (usually animal or vegetable oils) remain as one of the oldest examples of additive-type oils.

Petroleum Oils

During the transition period it became apparent that petroleum oils have very definite advantages over the older oils. One of these is greater stability in service. In an effort to enhance this quality even further, these oils were subjected to refining procedures to remove most of the oxidizable constituents. Although oxidation stability was increased, it became apparent that the removal of these constituents had depreciated certain other valuable characteristics, such as oiliness, pour point, etc, of the petroleum oil. Increasingly severe demands on oils for modern engines and the constant quest for improvement in equipment life and efficiency had made it necessary that lubricants have exceptional stability and oiliness, and other characteristics.



A turbine oil operating successfully for long periods may be expected to contain an oxidation inhibitor that prevents oxygen absorption and sludging. These oxidation inhibitors increase service life of lubricating oils to an amazing degree

In practice, one or both of the following methods are meeting this need:

1. Improved refining procedures to give better stability and lubricating characteristics.
2. Additive agents to improve these characteristics and add to the lubricating quality of mineral oils.

Method 1 involves selective refining procedures, which remove the more obnoxious constituents but leave small amounts of the beneficial components in the oil.

Method 2 may consist of returning some of the beneficial components removed and reclaimed during refining, but more often organic and metal-organic compounds or certain oxidized and chlorinated hydrocarbon conglo-

additives used in modern lubricating oils depends to a large extent on the type of service for which the oil is selected.

Thus, a turbine oil operating for long periods, particularly at high temperatures, may be expected to contain an oxidation inhibitor; a hypoid-gear lubricant will contain an extreme pressure (EP) additive, whereas a high-speed diesel lube oil will in all probability contain a detergent (cleansing) additive. Most of these service requirements boil down to seven characteristics required of all lubricating oils, given in the table, and satisfied more or less adequately by various special additive agents.

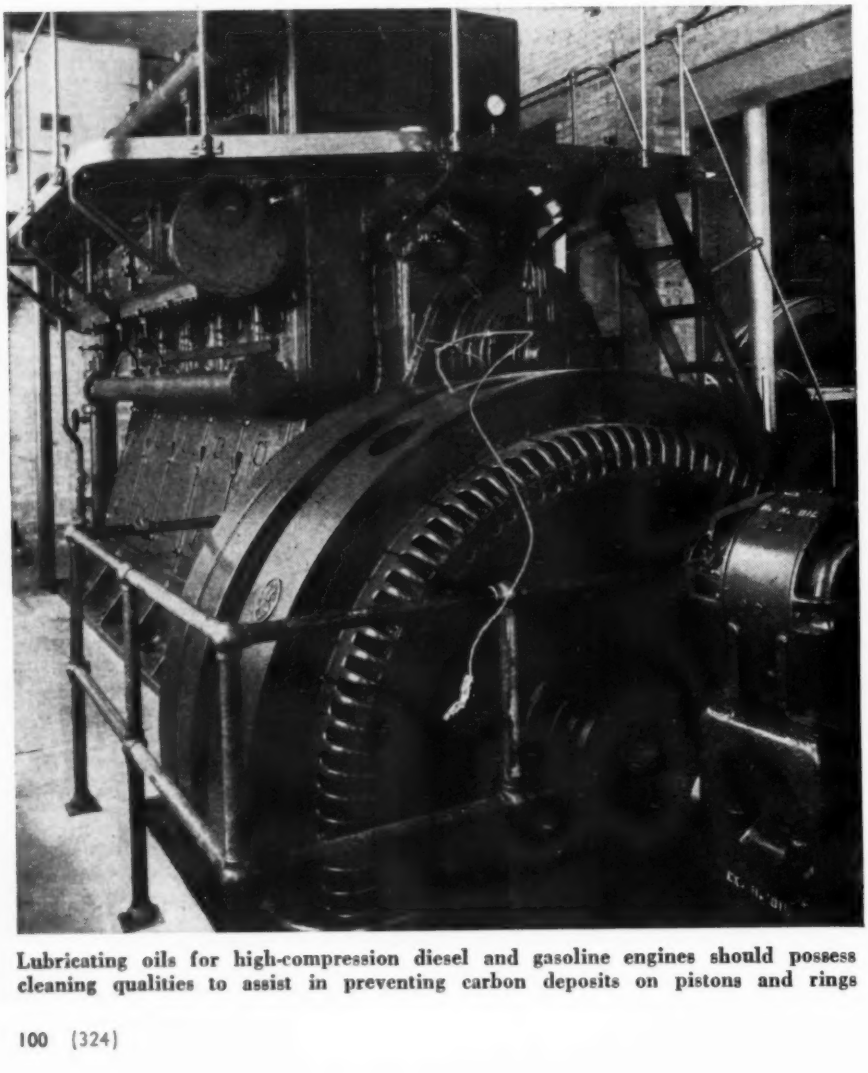
For those who have wondered about these additive agents' composition the following descriptions, beginning with the first item in the table, will prove of interest:

Seven Characteristics Required of All Lubricating Oils

Requirement	*Additives*
A. Low coefficient of friction	Oiliness agents
B. High film strength	Extreme-pressure agents
C. Stability	Oxidation inhibitors
D. Fluidity through operating temperature range	Pour-point depressants
E. Small viscosity change through operating temperature range	Viscosity-index improvers
F. Detergency	Detergent agents
G. Compatibility with water and steam	Emulsifying agents

A. Low coefficient of friction—oiliness. This requirement represents a problem of long standing. Extensive research by petroleum chemists in laboratories and in the field has made known a great number of oiliness agents, of which the more important ones are as follows:

1. Saponifiable oils, *voltolized* saponifiable oils (treated with high-voltage current) and blends of castor oil, lard oil, degras oil, rapeseed oil, neat's-foot oil, seal oil, olive oil, sperm oil and wool wax.
2. Fatty acids, such as palmitic acid.
3. Wax with fatty acids.
4. Organic esters, such as amyl benzoate, methyl salicylate, ethyl phthalate, ethyl benzoate, dibutyl phthalate, amyl acetate, butylene glycol stearate.
5. Soaps, such as lead, sodium, tin, aluminum and chromium oleates.
6. Halogenated esters; such as methyl dichloro stearate.
7. Halogenated hydrocarbons.
8. Halogenated fatty oils and acids.
9. Thio ethers, such as 3-carbomethoxy-4-hydroxyphenyl thio ether.
10. Oxidized petroleum products, such as oxidized paraffin wax and other hydrocarbons.
11. Organic phosphorus compounds, such as tricresyl phosphate.
12. Solid materials, such as soapstone, graphite, wax and lead oxide.



Lubricating oils for high-compression diesel and gasoline engines should possess cleaning qualities to assist in preventing carbon deposits on pistons and rings

B. High film strength—extreme pressure. This requirement may be considered a continuation of the first inasmuch as a low coefficient of friction is still mandatory only under the more severe circumstances of extreme loads and high temperatures such as are found in hypoid gears. Formerly similar conditions could be met only partly by making the oil's viscosity extremely high and suffering the attendant disadvantages. Additives have been developed, however, which greatly increase film strength, load-carrying ability and anti-welding properties without materially increasing the oil's viscosity.

Extreme-pressure lubricants are generally divided into mild and powerful extreme-pressure lubricants depending upon their load-carrying abilities. The dividing line between the two is not accurately drawn; consequently the following classification of the more important additives of these types may be considered only approximate.

1. Mild extreme-pressure agents include inactive sulphur in saponifiable oils, lead soap in oil, lead tetraethyl, inactive-lead-sulphur, sulphur-chlorine compounds.
2. Powerful extreme-pressure agents in-

clude active sulphur compounds such as sulphurized fatty oils, etc, active lead-sulphur compounds, lead-sulphur-chlorine compounds.

C. Stability—oxidation inhibitors. That an oil should be stable under its most severe operating conditions is a requirement familiar to all. Even minute quantities of decomposition products caused by oil breakdown may seriously handicap the operation of a turbine or engine because of impaired lubrication or corrosion of bearings and closely fitting parts. Oxidation inhibitors, which prevent oxygen absorption and consequent sludging have lately played an important role in increasing the service life of lube oils to an amazing degree. These compounds, of which only a relatively small number are here listed, may be conveniently divided into three main classes: (1) inorganic (2) organic and (3) metal-organic compounds.

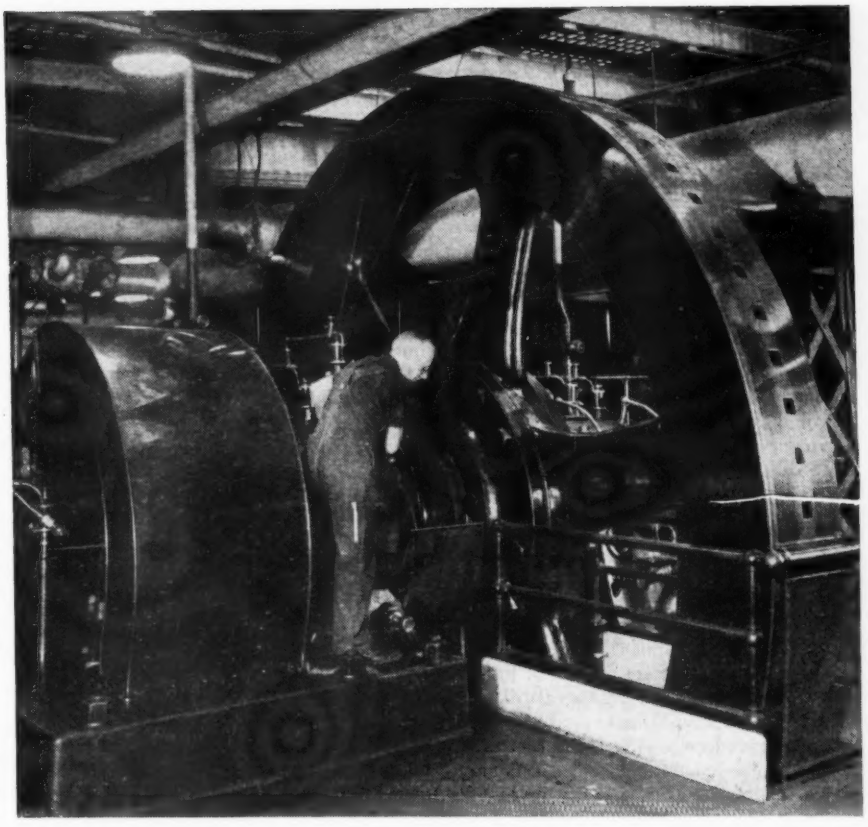
Antioxidant Agents

The following abridged list of antioxidants presented under 1, 2 and 3 headings shows that the number and types of chemicals lending stability characteristics to lubricating oils are quite extensive:

1. Inorganic compounds include selenium-sulphur compounds, tellurium-sulphur compounds and colloidal tin and colloidal-tin dioxide suspensions.
2. Organic compounds include amines, diamines, hydroxy compounds, hydroxy-diphenyl compounds, polycyclic aryl compounds having an inhibitor group (NH_2 or OH) and a stabilizer group (O or S atom) attached to the same ring, sulphur compounds, weakly basic compounds (usually as gum inhibitors in gasolines) and miscellaneous compounds such as anthranilic acid and phenylhydrazine.
3. Metal-organic compounds include aluminum, antimony, bismuth, cadmium, chromium, lead, mercury and tin compounds.

Of these numerous inhibitors for oxygen absorption, several compounds such as lead tetraethyl also have the advantage of raising the spontaneous ignition temperature of lubricating oils, thus further diminishing their tendency to decompose by cracking.

D. Fluidity through operating-temperature range—pour-point depressants. Oil must retain its fluidity and its lubricating value under the lowest probable operating temperature. This requirement is usually met either by completely dewaxing an oil or by partly dewaxing it, followed by addition of a pour-point inhibitor. The latter's chief merit is that it produces low-pour-point oils without removing the wax. Although obstructing oil flow at low temperatures by crystallizing into an interlocking, needle-like matrix, this wax has some highly desirable characteristics of which high viscosity index is one of the better known. The action of pour-point depressants, as proved by numerous photomicrographs, comes from their preventing growth of wax crystals to the interlocking or pour-preventing state.



Usually from 3 to 15% compound must be added to pure mineral oil used for steam-engine-cylinder lubricants to insure adequate wetting of the cylinder's surface

Most oils contain varying amounts of certain asphaltic and resinous materials which act as natural pour-point depressants. This is readily proved by filtering an oil through clay, which removes these substances, after which its pour point rises from 10 to 40 F. The pour point of an oil may also be lowered by adding asphaltic and resinous materials, such as those removed by clay treatment, but this method has found little favor among those interested in the problem because of degradation of the oil and the instability of such blends.

Certain soaps (of aluminum, magnesium, zinc, etc.) as well as esters have been found to lower the pour points of oils. However, because of their instability they may allow the pour points to rise to their original value under service conditions. Trouble with emulsions may also be encountered.

Mineral, animal and vegetable oils subjected to silent electrical discharges under specific conditions (called Voltol Oils) also give mineral oils lowered pour-point characteristics when blended with them.

One of the better known pour-point depressants is Paraflow, a complex hydrocarbon oil produced by reacting chlorinated paraffin wax with napthalene or similar aromatic nuclei in the presence of aluminum chloride (Friedel-Crafts reaction). Although Paraflow itself has a pour point of 25 F, the addition of a small quantity of this pour-point depressant to finished motor oils will lower the pour point of the blend 20 to 50 F without otherwise affecting the lubricant's characteristics.

E. Small viscosity change—viscosity-index improvers. Efficient lubrication also requires that the oil retain its viscosity characteristics as constant as possible over its entire range of operating temperatures. In other words, the oil should have a high viscosity index. In the past this requirement was met only by using a paraffin-base oil in preference to a naphthenic or mixed-base oil. The former is still the most popular but modern viscosity-index improvers make possible viscosity

indexes that are the same as or even higher than that of the best paraffin-base oil. Moreover, the viscosity index of these oils may be further increased by the addition of other agents of which some of the better known are:

1. Natural viscosity-index improvers. Certain natural fractions of petroleum act as viscosity-index improvers when added to light oils.

2. Voltol oils. Voltol oils, whose pour-point-depressing characteristics have been mentioned, improve the viscosity index of mineral oils. The viscosity-index change produced by adding Voltol to mineral oils may be as high as 30 points or more, improvement being greatest in the lower viscosity-index oils.

3. Paratone. A better known example of viscosity-index improvers in Paratone, prepared by polymerization of light ends of refinery gasoline to form a colorless liquid ranging in viscosity from fluid oils to thick liquids. Constituents of Paratone are essentially saturated paraffin hydrocarbons (chiefly exanol, a polymer). Effect of Paratone on low viscosity-index mineral oils is astounding. A 5% addition to a coastal distillate increases its viscosity index of 26 to 111. An equal amount added to a Pennsylvania oil increases its viscosity index of 100 to 128. Lubricants containing Paratone in appreciable amounts generally differ from normal petroleum distillates of the same viscosity by having higher volatility, lower Conradson carbon and higher viscosity index. The higher volatility presents no disadvantage, as proved by engine tests, and is greatly outweighed by the advantages of the lower Conradson carbon.

F. Detergency—detergent additives. Oils should lubricate efficiently even in the presence of obnoxious materials and reduce their effects. This requirement is especially important for diesel and gasoline engines because carbon deposition on pistons and piston rings is detrimental.

Complete refining of the lubricating fractions with special solvents has prevented this problem becoming acute. Another hopeful method seems to be removing high-boiling carbon-forming constituents from the oils and adding to them synthetic thickeners, such as Paratone, which is free from carbon-forming tendencies.

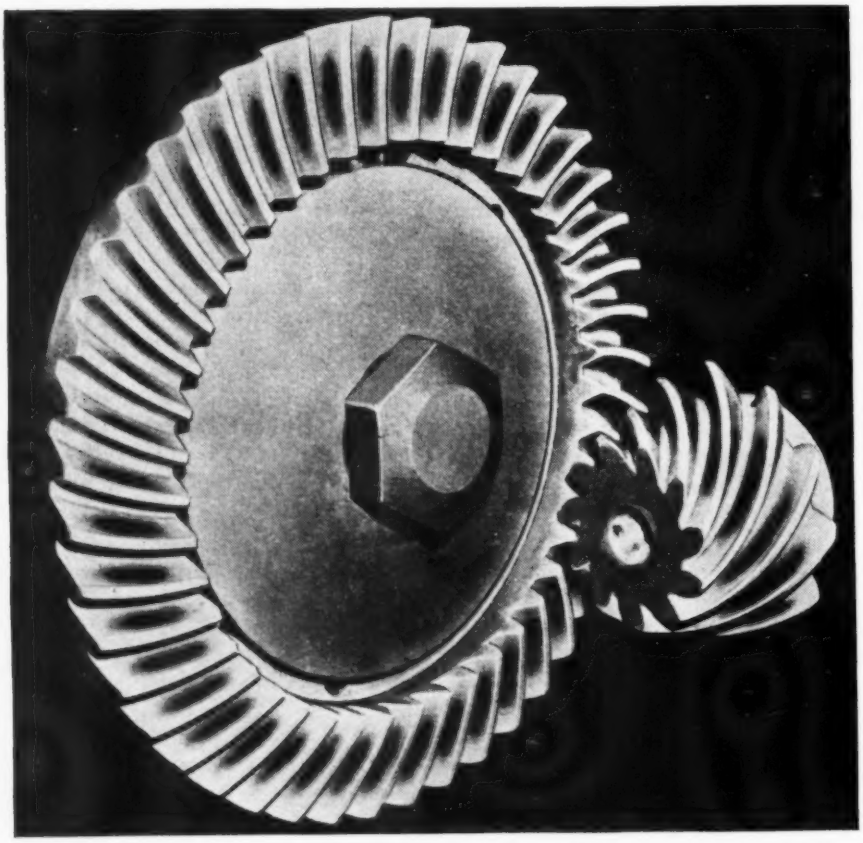
Notwithstanding these improvements, the latest automotive oils, in addition to containing oxidation inhibitors that prevent undue breakdown and carbonization of the lubricant, also contain certain detergent or "cleaning" agents to improve its qualities.

It can only be stated that one group of these materials comprises the various organic salts such as calcium and aluminum salts of naphthenic, phenyl-stearic or chlor-stearic acid. Of these, calcium naphthanate, calcium phenyl stearate, calcium stearate, calcium soaps of chlorinated stearic acids and calcium octyl salycilate may probably be considered as representative.

G. Compatibility with water and steam—emulsifying. Lubricating oils must also be suited to the atmosphere under which they must lubricate. Thus, in steam-cylinder lubrication, pure mineral oils are usually unsuitable because of their inability to coat metal surfaces in contact with water or steam. Usually from 3 to 15% compound must be added to a mineral oil to insure adequate metal-surface wetting in the presence of water or steam and to aid emulsification and spreading of the oil over large areas.

Steam-cylinder lubricants are generally residual, heavy-bodied mineral oils, filtered or nonfiltered, containing the proper amounts of one or more of the following compounding agents as required by the conditions of the steam pressures and temperatures under which they operate:

1. Nondrying fatty oils, such as acidless tallow oil, lard oil, degras oil, neat's-foot oil, rosin oil, sperm oil or rapeseed oil.
2. Colloidal graphite is also used to some extent for steam-cylinder lubrication, either in the form of oil or water suspensions. The former method is used for superheated or saturated steam and the latter for saturated steam only.



A hypoid-gear lubricant contains an extreme-pressure additive to give it high film strength to resist rupture by high pressure along the line of tooth contact

Blending Additives

Additive agents represent a great number of chemicals with varying degrees of chemical activity. Most of them alone will not react appreciably with the metal surfaces to be lubricated. However, because certain combinations of these chemicals may produce a corrosive action, blending a number of additive agents into one oil requires a thorough knowledge of the chemistry involved. The consumer must, therefore, observe a most important fundamental in the use of additive-type oils. Whereas mixing of lubricating oils in the field has been a more or less standard and comparatively harmless practice, the presence of even small amounts of certain additive agents in modern oils makes this practice dangerous and one to be avoided.

Users of additive-type oils should apply only one brand of oil to any one piece of equipment. If you change to another type of oil, do so only after thoroughly flushing the lubrication system with a plain mineral oil, kerosene, or other untreated hydrocarbon liquid.

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Increased Demand for Steam and Air Satisfied With 24% Less Fuel

For greatly expanded manufacturing operations, James J Fitzgerald, chief engineer, Chapman Valve Mfg Co, had to provide the necessary services while keeping an eye on restrictions for new equipment and the national fuel-conservation program

AFTER THOROUGH STUDY, Chief Engineer Fitzgerald, of Chapman Valve Co, Indian Orchard, Mass., concluded that rejuvenating the plant's over-age boilers and steam-driven air compressors would not only increase power output but would also reduce fuel consumption. These improvements, together with a new heater that heats boiler feedwater to 212 F instead of 160 F, an additional vacuum-return pump, thermostatic control for large unit heaters, adequate feedwater treatment and the collection and return of all condensate to the boiler room, produced a fuel saving of 24%. Here is a short description of Mr. Fitzgerald's plant and the improvements he made.

Fig. 1—Chief Engineer Fitzgerald makes preliminary studies of proposed piping layout, including a new service pump. Shallow wells supply process water

Since factory electricity (about 12,000 kw) is purchased from the local utility, only steam, air and water have to be supplied privately. Steam for heating comes from two low-pressure boilers, Fig. 2, isolated from the main power plant, and the exhaust from steam engines. Air is supplied by two 1100-cfm 2-stage synchronous motor-driven compressors in one section of the factory, and two steam-driven units in the main engine room.

Principal power plant consists of four 1500-sq-ft 150-psi Manning boilers, Fig. 3, two 908-cfm steam-driven air compressors, Fig. 4, one 100-kw and one 75-kw dc generator, Fig. 5, direct driven by steam engines, and the necessary station auxiliaries. The dc generators furnish power for electromagnets, throughout the factory, which handle castings and parts.

An isolated boiler plant, which supplies heat to a section of the factory, consists of two 1000-sq-ft 7-psi oil-fired boilers. Condensate returns by gravity to a pump in the boiler room that lifts the water to an elevated tank from which it flows to the boilers by gravity. Boilers are equipped with float-operated water-level regulators and high- and low-water alarms and cutouts. Complete control on feedwater and oil burners makes the boilers fully automatic. Originally the steam main from these units connected to exhaust header from main power plant, but erratic pressure fluctuations made operation unsatisfactory and they are now separated. Insulating many steam lines that had formerly been

uncovered prevents considerable loss.

Most of the improvements are in the main power plant and the factory area that it heats. Originally a great quantity of this condensate was allowed to go to waste. Installing thermostatic control on the large unit heaters cut down steam usage; a vacuum pump now returns condensate from this section to the boiler room. A second vacuum pump in the boiler-room basement takes care of condensate from the remaining branch of the system. Both pumps discharge into a common float-controlled receiving tank. From here the water goes to the boiler-feed pumps and then through the feedwater heater to the boilers. Treating chemical is introduced to individual boilers through injectors.

Before the war, the main power plant supplied steam for only one engine-driven generator and for heating a section of the factory—a load well within its capacity. At that time the motor-driven air compressors in the factory supplied the necessary air so that the steam-driven units did not operate.

Increasing demands for more steam, dc power and compressed air made it imperative either to install new equipment or to improve the old. First consideration was the four 35-year-old boilers. Could new units be secured or would the old ones have to be repaired to increase their steaming capacity? The critical materials situation, which meant a minimum of new parts for the job, dictated the answer.

Boiler Repairs

For a start, one boiler at a time was removed from service for general overhaul. Tubes were badly scaled and a considerable number were leaking. The answer was to retube each boiler, and replace staybolts where needed. A traversing soot blower, installed in the smokebox, and new feedwater regulators completed the boiler improvements.

The new feedwater heater, replacing one that was badly scaled and corroded, uses exhaust steam at 5 psi to heat the feedwater to 212 F. A pressure-operated diaphragm valve in the steam supply to each of two turbine-driven feedwater pumps maintains constant water pressure at feedwater regulators. With these improvements the boilers can supply enough steam to operate both engine-driven dc generators and the two steam-driven air compressors. All four machines exhaust at 5- to 7-psi backpressure into the heating mains. An instrument panel in the engine room carries numerous gages that facilitate plant

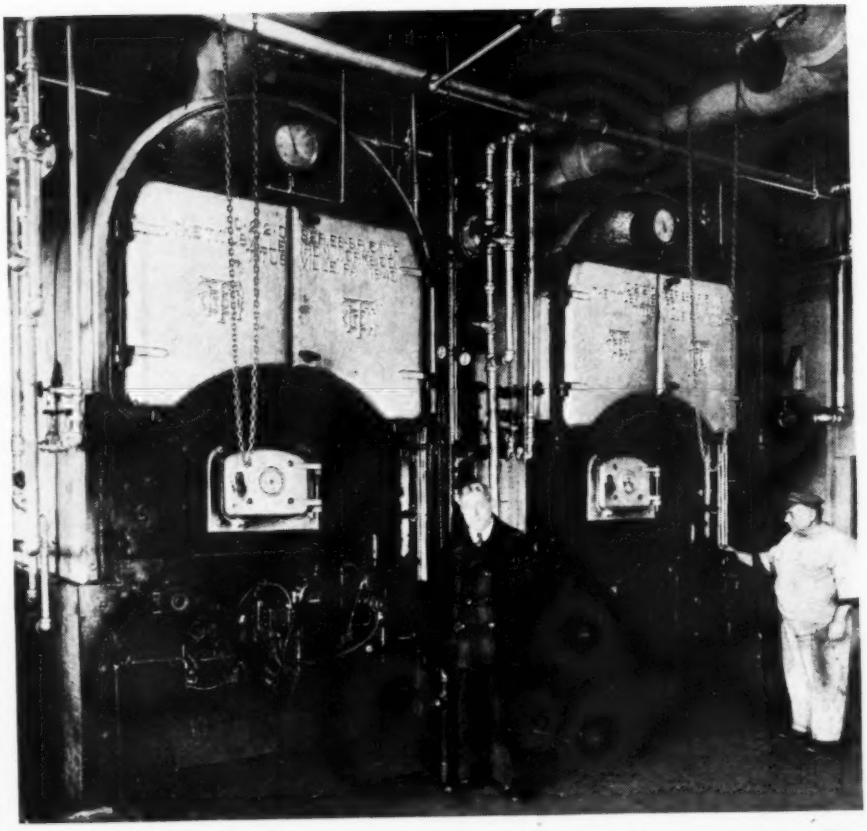


Fig. 2—Two 1000-sq-ft 7-psi oil-fired boilers heat one factory section. Protection includes water-level regulators, high- and low-water alarms, cutouts

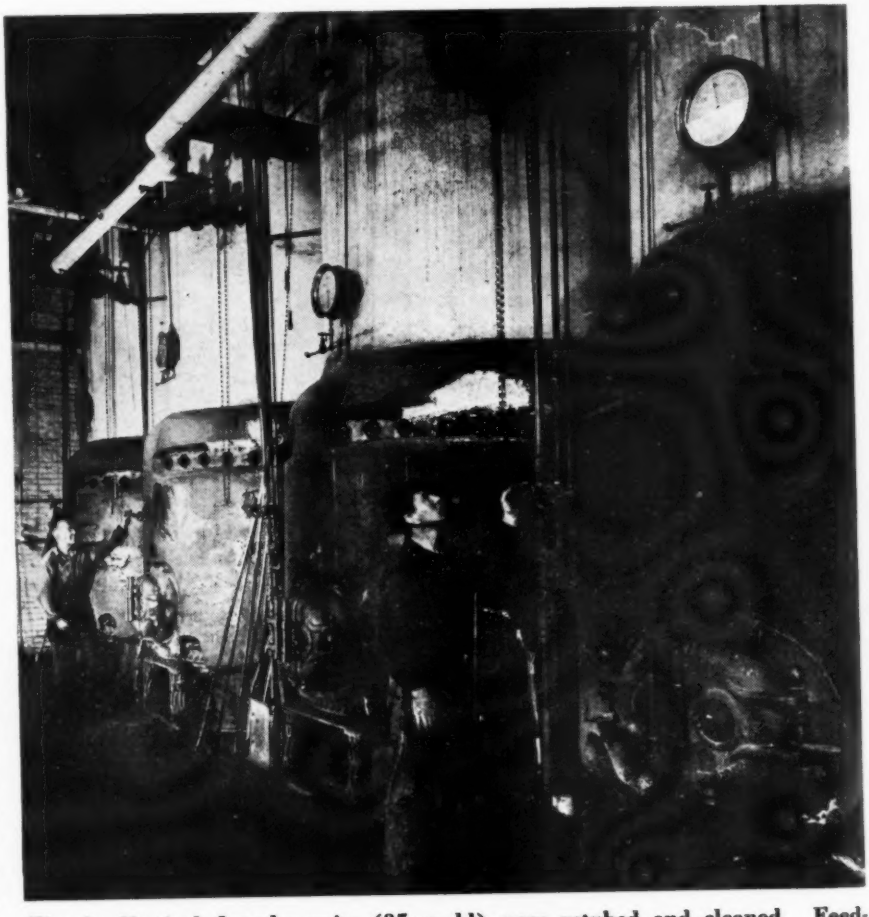


Fig. 3—Vertical firetube units (35-yr-old) were retubed and cleaned. Feedwater regulators and faulty staybolts were replaced, and soot blowers were added

supervision from one centralized point.

Additional steam for heating, over and above that supplied by engine exhaust, comes from the main steam header through a pressure-reducing valve. Although the boilers carry the additional power load, sufficient steam is not available to maintain optimum temperature in some parts of the factory during extremely cold spells. This causes no discomfort because the type of work permits wearing heavy clothing.

The steam-driven 2-stage 100-psi air compressors as originally installed carried air cylinders fitted with obsolete corliss valve gear. Since valves, cylinders and pistons were worn and leaked badly, measures had to be taken to reduce the loss in efficiency. Because new units could not be had, the manufacturer's engineers were consulted to learn the best way to make repairs.

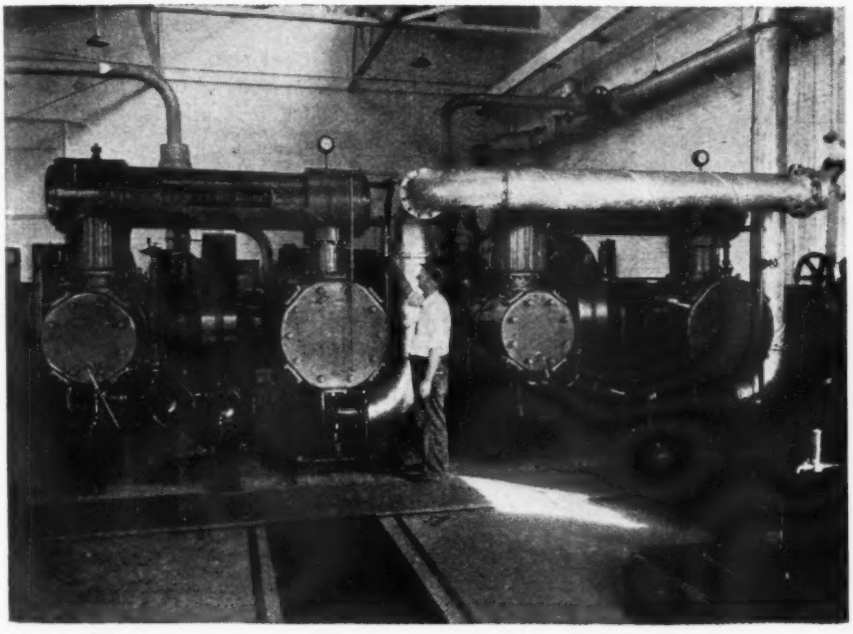


Fig. 4—Fitting compressors with new air cylinders and modern valves reduced the steam rate, increased the volumetric efficiency and discharge capacity

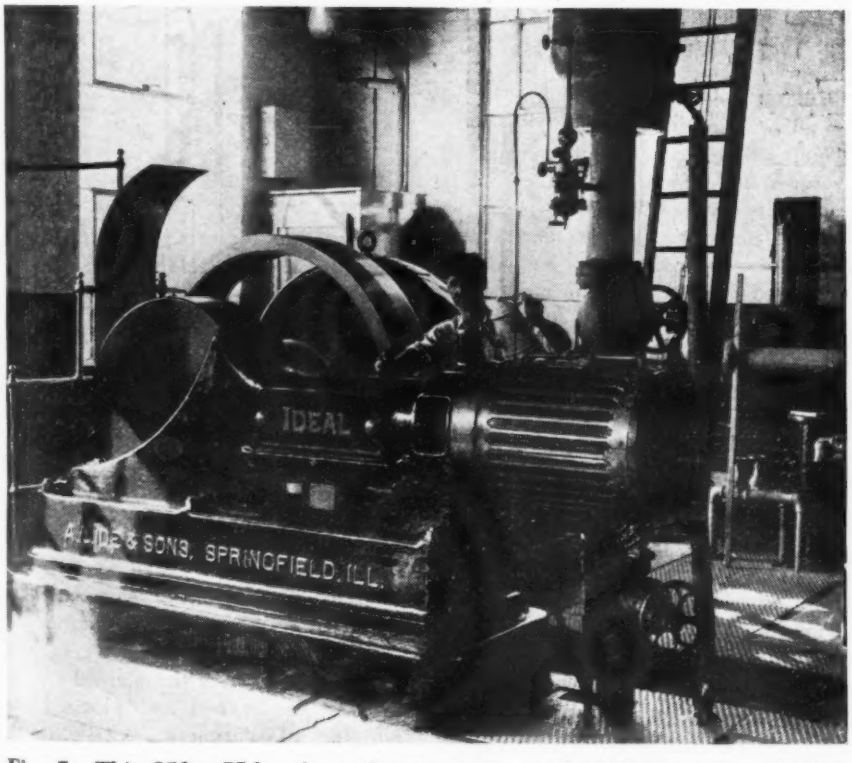


Fig. 5—This 250-v 75-kw dc engine-generator set furnishes power to lifting magnets in the factory. A 100-kw unit (not shown) completes the dc supply

They suggested replacing the old air cylinders and valve gear with modern cylinders fitted with channel valves. This change not only eliminates leakage but also increases volumetric efficiency and reduces mechanical losses introduced by the heavy corliss valve mechanism.

Operating at 170 rpm, the old 19 and 12x16-in. air cylinders had a displacement of 888 cfm and discharged 700 cfm when first installed (a volumetric efficiency of 79%). New 20 and 12½x16-in. compressor cylinders were installed which, now operating at 180 rpm, have a displacement of 1042 cfm and discharge 908 cfm, giving a volumetric efficiency of 87½%. Steam rate was also reduced about 10% by these changes and improvements.

Machine Re-aligned

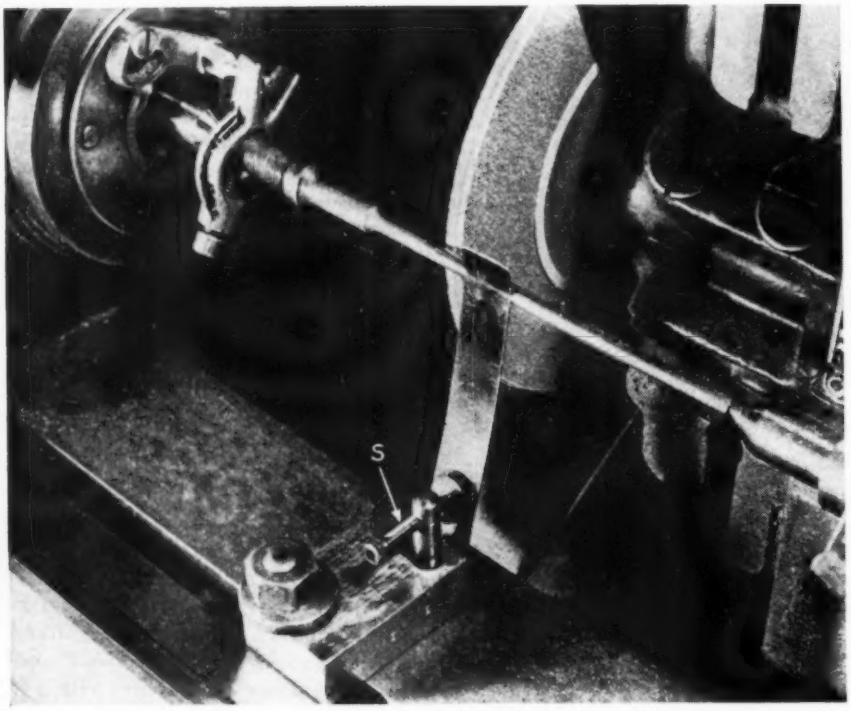
Speedy repairs were imperative because the machines had to be returned to service at the earliest possible time. No. 1 compressor was off the line eight days because originally it had not been properly aligned. The low-pressure frame was found considerably lower than the high-pressure side. Chipping the grout away from the bedplate permitted jacking the frame up and leveling it with its mate. The foundation was then built up to proper height and the frame grouted in place. No. 2 compressor was out of service only five days because releveling was not needed.

Complete air ends, including matched intercoolers, were added to each compressor with cooling circuits in series—water flows through intercooler, low-pressure and high-pressure cylinders. A bypass on the intercooler discharge goes to a sight funnel so that if more water is needed in the intercooler it can be discharged without passing through cylinder jackets. Local requirements dictated that new intercoolers be installed on these compressors, but when original ones are ample size and in good condition they usually can be fitted to the new cylinders.

As formerly installed, both compressors used a common intake pipe. Present improvements include separate intakes of adequate diameter, each mounting its own ample-sized air filter. The old aftercooler was cleaned, put in good condition and connected into the common discharge line. A large air receiver mounted outside the room provides adequate storage capacity. Moisture traps on intercoolers and aftercooler remove condensate. Moisture content of delivered air is not high enough to interfere with tool lubrication.

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



SPRING STEADIES ROD DURING GRINDING

A SPRING steady rest, as in the photo, devised by H Rennie in the punching, tool and die division at General Electric's Schenectady works, eliminates vibration while small-diameter rods are being ground to close tolerances. This easily constructed device has reduced spoilage of these precision parts.

Attached to the end of a base by a bridge clamp, the upright spring rests against the center of the rod under pressure to support the work. The bridge clamp avoids weakening the spring with screw holes, which would otherwise be necessary. Screw *S*, used to adjust spring pressure, has a spherical end made of a steel disk and a leather pad. The pad gives a cushioning effect between the two metal parts and tends to absorb vibration through the spring.

Don't Judge Pumps By Their Speed

FREQUENTLY a purchaser assumes that liquid velocity in a 3450-rpm centrifugal pump is twice that in one operating at 1750 rpm. Accordingly, he objects to installing the higher-speed pump thinking that the liquid velocity is too high through the impeller's passages for good efficiency.

Actually if pumps are properly designed, liquid velocity through those of equal capacity is practically the same regardless of speed at which they operate. For example, consider a 50-gpm pump for 75-ft head. A pump manufacturer's data show that these conditions can be met by a 1750-rpm or a 3450-rpm pump.

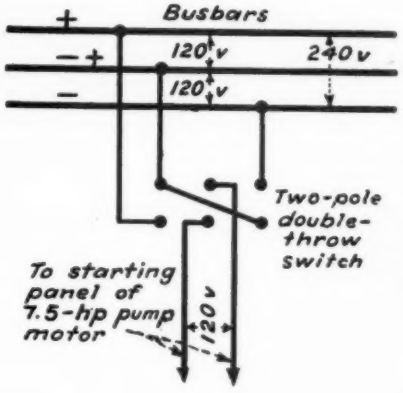
The 1750-rpm pump has an impeller 9 in. in diameter and the 3450-rpm pump a 4⅝-in. one. The peripheral speed of the 1750-rpm impeller will be $9 \times 3.1416 \times 1750 \div 12 \times 60 = 68.7$ ft per sec and that of the 3450-rpm impeller, will be $4\frac{5}{8} \times 3.146 \times 3450 \div 12 \times 60 = 69.6$ ft per sec.

Thus, if peripheral speed is a measure of the velocity of the liquid through the impeller, it is practically the same in both pumps. From this consideration there is little choice between the two speeds.

New York, N. Y. FRANK A. KRISTAL

Balances Three-Wire System with Pump Motor

ONE 200-kw and three 400-kw 3-wire 120-to-240-v engine-driven dc generators supply power to a large office building. Generator positive and negative circuit



breakers are set to trip at 50% overload, but the neutral breakers have a maximum trip setting of 18% generator full-load rating. If a neutral breaker opens, it simultaneously trips the corresponding positive and negative breakers.

During the day, unbalance of load on the two sides of the system remains well within the setting of neutral breakers, but it sometimes causes trouble at night when the small generator only is needed. When the load drops in the evening the unbalance frequently does not change proportionately. Several times when only the 200-kw generator has been in service the neutral circuit breaker has opened and plunged the building into darkness.

Occasionally when the evening load goes down to 800 amp, where it can

be carried by the 200-kw unit, the change cannot be made because unbalance would trip the generator's circuit breakers. This condition has delayed the changeover even when the load had dropped to 400 amp, 50% of the generator's rating.

Usually this condition can be corrected by shifting 120-v circuits from one side of the system to the other. However, on some nights the heavy load is on the positive, and other nights on the negative side of the system. This depends upon tenants who work at night and the sections of their space where they work. Positive and negative feeders were interchanged at the switchboard switches to balance the night load, only to find it badly out of balance on the opposite side a few nights later.

What we needed was load that could be readily switched from one side of the system at will to help keep it in balance. This we found in a 120-v 7.5-hp motor driving a centrifugal pump for the ventilating-system air washer. We connected this motor to a double-throw switch, as in the diagram, so that it can be operated on either side of the power system to help balance the load.

Even though the pump motor load is only 45 amp when connected to low side of the system, it is sufficient to keep the neutral current within safe limits for the small generator. If the operator sees that the load on the motor side of the system is getting too heavy he can switch it to the other.

The pump suction and discharge are also connected through valves to a tank that is filled with water in winter when the air washer cannot operate. When the operator sees the load getting dangerously out of balance he starts the pump and recirculates the water in the tank. The discharge-line valve is partly closed to give the desired load on the motor. This is an emergency device and is used only when necessary.

Ramsey, N. J. R W RIORDAN

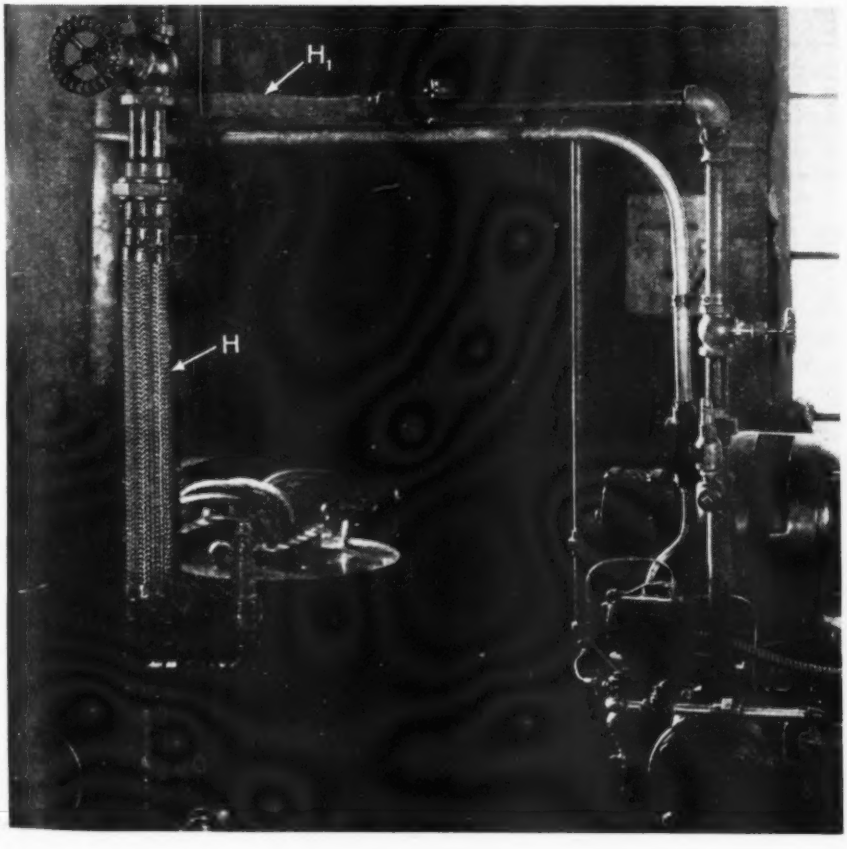
FLEXIBLE HOSE KILLS COMPRESSOR NOISE

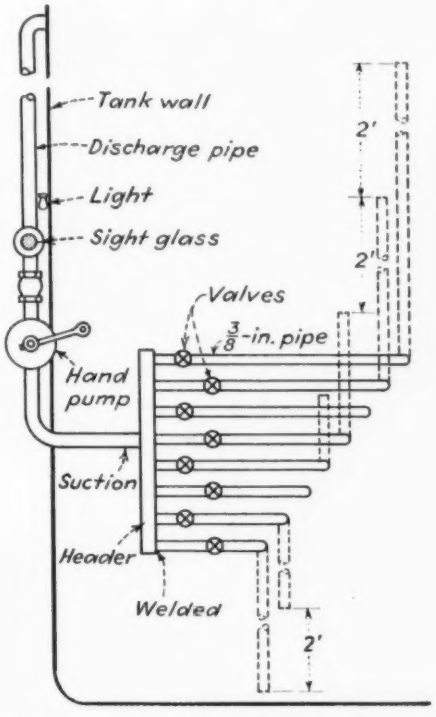
WHEN IN OPERATION our air compressors made an excessive amount of noise. After several attempts to quiet them I discovered that the noise of the valves on their seats was apparently being transmitted by the discharge piping to the receivers. The latter acted as a sounding board to amplify the sound many times.

Once the cause was discovered the cure was simple. I installed a section of flexible metallic hose in the discharge pipe of each of the two compressors, as in the photo. On one compressor the hose *H* was installed in the vertical pipe and on the other in the horizontal pipe at H_1.

In either place it was effective in deadening the noise. Before these hose sections were installed you could scarcely hear yourself speak. Now the noise level is normal and the plant a pleasant place to work.

Englewood, N. J. R BOETTINGER





Sampler Checks Water Level in Fuel-Oil Tank

WATER IN FUEL OIL is a constant headache aboardship because empty fuel-oil tanks are often flooded with water for ballast. It is almost impossible to remove all ballast water from these tanks. To overcome this difficulty we installed on a settling tank the water-level testing device in the figure.

We connected eight 3/8-in. pipes through the side of the tank and extended their suction ends so that one would be about 2 ft above the other. This permitted sampling the tank contents at each 2-ft level. These pipes we connected through valves to a header, which we piped to a small hand pump, a check valve, sight glass and back to the settler tank's top.

When we want to test for water we open a valve in a pipe that reaches to,

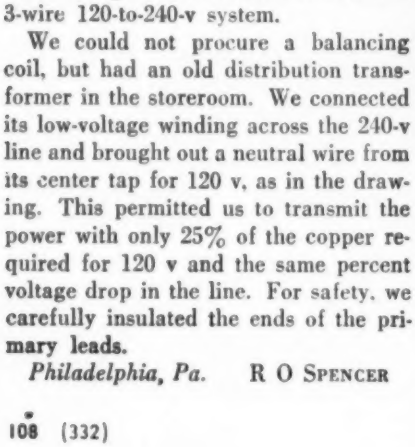
say, the 6-ft level. Then we operate the pump for several strokes, sufficient to draw liquid from the tank and discharge it through the sight glass back to the top of the tank. The liquid in the discharge pipe is then allowed to remain still for a few minutes so that any water it contains will show in the glass. If there is water we sample again at a higher level. In the absence of water a sample is taken at the next lower level. After its level is determined we pump the water overboard before starting to burn the oil from the tank.

Great Neck, N. Y. S M ELONKA

Transmits Power 2-Wire and Converts to 3-Wire

RECENTLY we had to supply a 120-v light-and-power load about 500 ft away from a 120-to-240-v distribution panel. We could have run a 120-v 2-wire or a 120-to-240-v 3-wire line to the load.

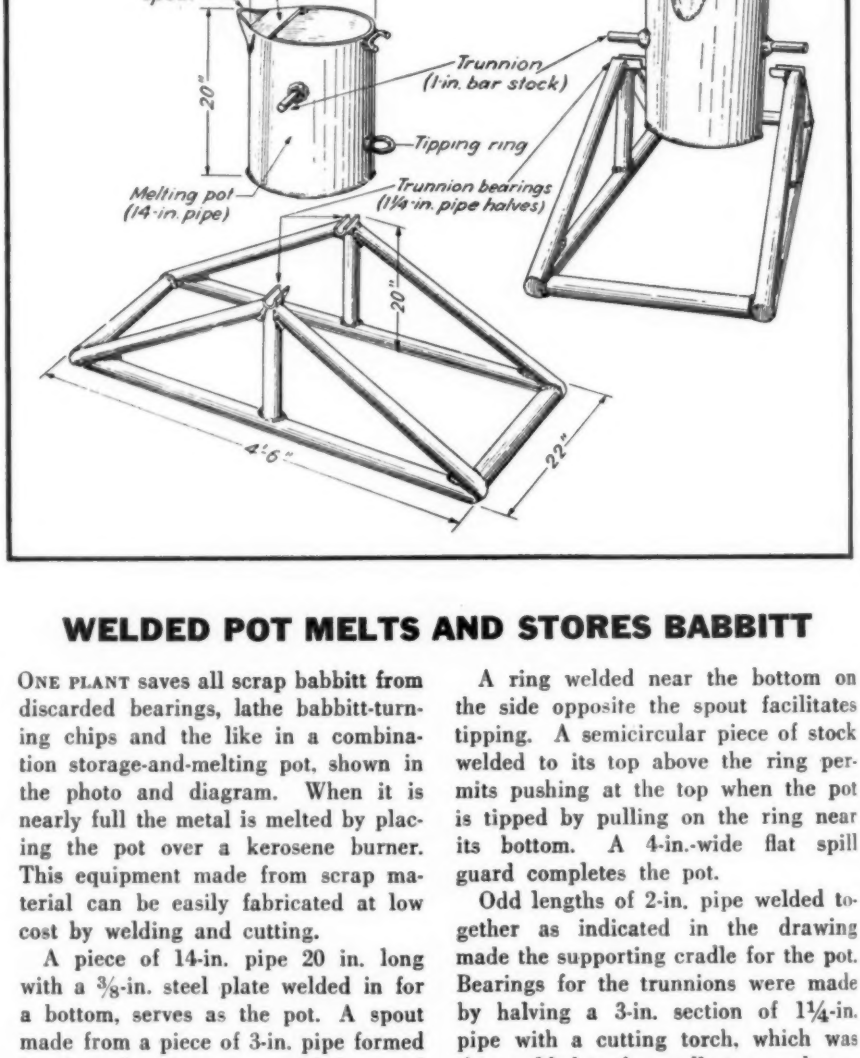
The 2-wire line would have had a high voltage drop when small single-phase motors were started unless the line conductors were unusually large.



A 3-wire 120-to-240-v line could have done the job successfully with less copper than a 110-v 2-wire installation. However, the copper in the neutral of the 3-wire system would not have been used efficiently so we hit upon the idea of running a 240-v 2-wire line and using a balancing coil at the load to obtain a 3-wire 120-to-240-v system.

We could not procure a balancing coil, but had an old distribution transformer in the storeroom. We connected its low-voltage winding across the 240-v line and brought out a neutral wire from its center tap for 120 v, as in the drawing. This permitted us to transmit the power with only 25% of the copper required for 120 v and the same percent voltage drop in the line. For safety, we carefully insulated the ends of the primary leads.

Philadelphia, Pa. R O SPENCER



WELDED POT MELTS AND STORES BABBITT

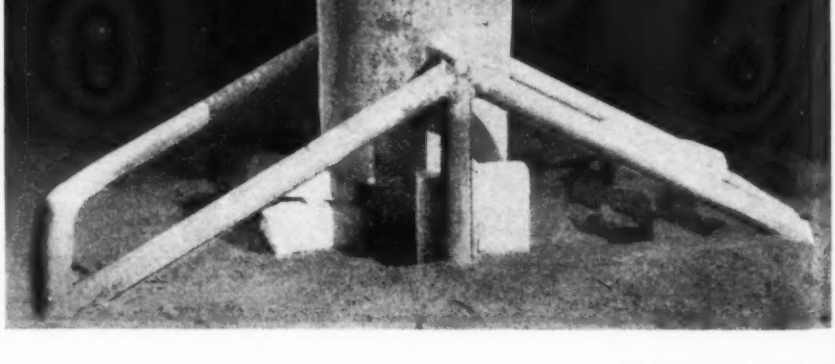
ONE PLANT saves all scrap babbitt from discarded bearings, lathe babbitt-turning chips and the like in a combination storage-and-melting pot, shown in the photo and diagram. When it is nearly full the metal is melted by placing the pot over a kerosene burner. This equipment made from scrap material can be easily fabricated at low cost by welding and cutting.

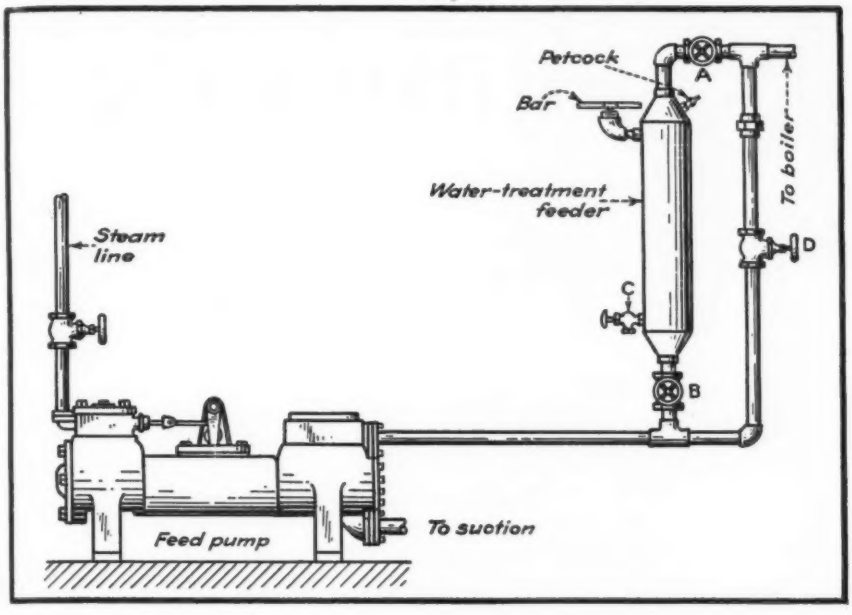
A piece of 14-in. pipe 20 in. long with a ⅜-in. steel plate welded in for a bottom, serves as the pot. A spout made from a piece of 3-in. pipe formed in triangular shape was welded around a U-shaped cut in the pot's rim. Two 4-in. lengths of 1-in. round steel stock, welded perpendicularly to the pot's wall, form the trunnions. These are positioned on opposite sides, 90 deg from the spout and 12 in. from bottom of pot so that, even when empty, it will hang in a vertical position.

A ring welded near the bottom on the side opposite the spout facilitates tipping. A semicircular piece of stock welded to its top above the ring permits pushing at the top when the pot is tipped by pulling on the ring near its bottom. A 4-in.-wide flat spill guard completes the pot.

Odd lengths of 2-in. pipe welded together as indicated in the drawing made the supporting cradle for the pot. Bearings for the trunnions were made by halving a 3-in. section of 1¼-in. pipe with a cutting torch, which was then welded to the cradle top as shown. Before welding, take care when assembling the cradle to have the different parts in good alignment. This pot is inexpensive to make and by its efficient reclamation aids materially in conserving babbitt.

New York, N. Y. G C BECKER
The Linde Air Products Co





CLOSED WATER-TREATMENT FEEDER

AT ONE PLANT where I worked boiler-water treatment was put in the feedwater heater, which was vented. As a result much of the volatile material in the treatment was lost through the vent. To correct this condition we made a feeder and installed it in the feed-pump discharge pipe, as shown in the diagram.

We made the treatment container from a piece of 3-in. pipe tapered at the ends by slotting and welding. To each tapered end we welded a pipe coupling for connection to the pump discharge pipe. Connections were made at the container's top for a filling connection and at its bottom for a drain valve, as shown. A petcock, for air relief when filling the container, completed the feeder. We would have used a valve instead of the plug in the filler connection but in war times the plug saved a ¾-in. valve. To make it more convenient to remove and screw in the plug we brazed a bar to its top.

With valves *A* and *B* closed in the feeder connections, drain valve *C* is opened to drain the feeder after which the relief cock is opened and the filler plug removed. After the feeder has drained, valve *C* is closed and the treatment poured into the container, the petcock closed and the filler plug tightened in place. By adjusting the openings of valves *A* and *B* the rate at which the treatment is fed into the boiler can be regulated.

Before filling the feeder with treatment, open valves *A* and *B* and close valve *D* so that all feedwater will pass through the container to clean it thoroughly. Tapering the container's ends eliminates any pockets in which treatment might settle from the solution. Container's size can be calculated from the amount of solution used at each filling.

Shiprock, N. M. JAMES F MAHER

Noisy Operation Not Always Caused by Pump

WHEN A CENTRIFUGAL PUMP is correctly selected and installed, it should operate smoothly and quietly. Noisy operation, even if the pump does deliver rated capacity and pressure, indicates that something should be corrected.

For example, a high-pressure booster pump was noisy and caused complaints from tenants in the office building where it operated. When the pump company's service engineer found nothing apparently wrong he decided to send the pump back to the factory for a test. However, when he removed the bolts connecting the discharge pipe to the pump, the pipe moved to one side about one-half inch, indicating that it had been sprung to position when installed. To check whether the pipe had put sufficient strain on the pump's casing to distort it and cause noisy operation, the service engineer adjusted the pipe so that its flange lined directly with that of the pump and replaced the bolts. When the pump was again started it operated quietly showing that straining the discharge piping into place had caused the trouble.

Noise may be difficult to locate and to stop since no two noisy pumps seem to fit a similar pattern. A service engineer, going to a job on a noise complaint, is very much on his own, and frequently cannot draw upon previous similar experiences to help analyze the trouble.

Sometimes the pump may not cause the trouble even though it is blamed. For instance, in a large apartment hotel a tenant on the twelfth floor complained about noise when the house pump was operating. When standing in his apartment while the pump was running the noise was very evident. The pump company's service engineer checked everything about the pump, even to standing a pencil on its casing while it was running to show that there was no vibration. The pump room was quiet while the noise was at its worst in the twelfth-floor apartment.

To make sure that the discharge piping was properly supported, one of the helpers followed it through the building, and located a loose pipe hanger at a bend on the tenth floor. With pump in operation the piping vibrated at this elbow, and tapped against the loose hanger. This caused the noise that was telegraphed to the twelfth-floor apartment. Tightening the pipe hanger removed the trouble.

Sometimes the pump service engineer is not as lucky as in these two instances. The pump may be sent back to the factory for further checking when the trouble is caused by improper or careless installation.

New York, N. Y. FRANK A. KRISTAL

Dispenses Oil By the Foot

ONE COLD MORNING the pipe foreman in a powerhouse building sent a helper to the stock shed for a quart of lard oil. The old man in the stockroom found that the oil had congealed so it wouldn't run out of the spigot. What to do!

After some thought he fitted a tire valve stem in the bung and applied an air pump. The oil was neatly coiled in the helper's pail; but how to charge it to the stock order was more of a problem. After some thought and "figgering" he made the following entry; 50 ft of ⅜-in. lard oil, and so passed the worry along to the boys in the accounting department.

Schenectady, N. Y. N L REA

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

Questions from Our Readers

1—Will the Motors Work in Parallel?

WE HAVE A COMPRESSOR that requires a 50-hp drive but are unable to secure a motor of this size. It has been suggested that we remove two 25-hp shunt-wound dc motors from idle machines and use them for this drive.

Space is available to arrange the motors for belt drive either with one driven pulley and one belt running on top of the other or with two parallel driven pulleys. One 25-hp motor can start the machine unloaded but both have to be energized before compressor is loaded (machine is fitted with solenoid-operated unloaders). Since both motors are to drive the same load, overload relays can be connected to trip individual circuit breakers or one common to both motors in the main feeder.

Will the drives prove equally satisfactory? Also, how should the motors be connected electrically? Must both starters be mechanically connected so that they move in unison? Will we need a vernier rheostat in one motor's field circuit to better equalize the load? Can unloaders be wired to operate automatically? List other precautions—*LCL*

2—What Prevents Condensate Return?

WE HAVE a 2000-ft pipeline that returns condensate from the laundry to the boiler room. The line then rises vertically to enter the feedwater heater 25 ft overhead. A valve at the foot of the riser permits draining the line. A total of fifteen ¾-in. and six 1-in. traps (connected to the 100-psi steam main) discharge into the return.

When laundry returns from two mangles, two dryers, six pressers and a low-pressure steam generator are discharged into the return line all machines get cold within one hour. Upon opening the drain valve at the boiler-room riser considerable air discharges, then a slug of water, and again a pocket of air. Is poor operation caused by air leakage? Suggestions for correcting this trouble will be appreciated.—*CHH*

Answers to March Questions

Does Our Plant Warrant Unit Drive?

(This is Question 1 from the March issue, with best answers from readers.)

WE ARE AT PRESENT *driving our plant by steam power through line shafts belted to the machines. One, 60 ft long, is driven by an 18x18-in.-cyl 110-rpm 150-psi 270-hp steam engine. Another shaft running at right angles to the first, but not connected to it, is driven by a 20x20-in.-cyl 170-rpm 150-psi steam engine.*

Machines connected to the first shaft are: two planers, a 6-in. band saw (600 rpm), a blower, two trimmer saws and a transfer chain. Manufacturer's specifications require a 70-hp electric motor for each planer, a 40-hp motor for the band saw, a 40-hp motor for the blower, and a 25-hp motor for transfer chain and trimmer saws combined.

The second shaft drives a 7-in. band saw (585 rpm) requiring a 50-hp motor, two 6-in. band saws that require a 40-hp motor each and one blower that requires 25 hp.

We are now considering moving the two 6-in. band saws in front of the planers so that lumber will travel directly from the saws to the planer table. This move means installing a right-angle drive for the saws and entails more expense in shafting, pulleys and belts.

Present operating and maintenance cost in belting, greases, oils and lace leather is considerable. Foundations are not sound and we experience trouble with bearings coming out of line.

Is it advisable to convert all machines to electric drive or just equip the two 6-in. saws with electric motors, buy power, and leave the planers with their present drive? Is one engine large enough to motorize the plant so that we can discard the second? How much generating capacity will we need? Should we use dc or ac and at what voltage? Also what type of motors should we use? We have two 150-psi hrt boilers equipped with dutch ovens burning shavings and sawdust.—JDW

Maintenance Lower On Unit Drive

ANALYZING JDW's problem shows he has a total-connected machine load of 400 hp of which 245 is carried by the smaller engine and 155 by the larger one. In addition, there is a lineshaft load of probably 20 to 25 hp depending upon the number, size and type of pulleys, the number of bearings on the lineshaft, kind of bearings, and shaft speed.

The 20x20-in. engine at 170 rpm should develop about 500 hp and be of ample size to handle the entire load because only a few of the machines operate at full load at any one time.

Efficiency of an electric generator and motors combined is probably somewhat less than that of the lineshaft drive, but there should be some compensating increase in engine efficiency from better loading. By taking indicator diagrams of both engines with all machines running unloaded maximum base load may

be obtained. It may be somewhat as follows:

2 planers at 15 hp	30
1 bandsaw, 6 in. at 7½ hp	7.5
1 blower	25
2 trimmer saws and transfer chains	10
1 lineshaft, 60 ft. long	10
1 bandsaw, 7 in.	10
2 bandsaws, 6 in. at 7.5 hp	15
1 blower	15
1 lineshaft	10
Maximum base load, hp	132.5

This leaves a variable load of about 287 hp divided among ten machines, which would require a high degree of coordinated operation to average 60% of full load or, say, 172 hp which, combined with the base load, amounts to about 305 hp total load.

There may be short peaks that exceed these figures, but the flywheel effect of the engine, generator and motors should iron them out considerably. A 300- to 350-kw generator at 80% pf should be ample to handle the load, and maintenance cost of the electric drives will be less than that of the present system. Alternating current at 440 v, 3 phase, should prove most satisfactory because standard equipment is readily procurable in normal times. Dust-tight, fully inclosed motors are easier to maintain than open ones, but cost more and are not so readily procurable. Some standard motors of recent design are almost totally inclosed and if properly ventilated operation is trouble free for long periods of time.

It is seldom economical to buy electric power to operate part of a plant when there is an ample supply of cheap fuel, even though power rate is low. A careful study of plant load conditions may indicate that the smaller engine is large enough for the job. Steam economy may not be of much concern here, but the engine's ability to maintain its speed with close regulation for all loads is important.

Oak Ridge, Tenn. I A BUTCHER

Wound-Rotor Motors For Large Machines

ASSUME THAT WOOD REFUSE furnishes ample boiler fuel and that this would be wasted if power were purchased. If power rate is low enough, purchased power may be cheaper because, aside from fuel, there are other costs in a boiler plant. However, no information is given that warrants a statement concerning purchased power so I assume that it is not to be used for the entire plant.

Individual drive has advantages over group drive for machines in a woodworking plant. For instance, those not in use can be shut down to save power. There are no belt or lineshaft losses, shaft alignment or shaft-bearing troubles, belt hazards, loss of space, ventilation or vision from belting, and no expense for belt dressing, repairs or upkeep, photo 1-A.

Use standard 60-cycle 3-phase current. Direct current gives better speed control but in the plant under discussion this is not important. For the larger machines use wound-rotor motors to make starting easier. There is not enough generator or engine capacity to start large squirrel-cage motors without serious speed and voltage variations which interfere with the operation of running motors. A certain amount of speed control can be obtained with the wound-rotor motors if the starting equipment is designed for such duty. The need should be considered when ordering motors and control.

The single 20x20-in. 170-rpm engine should handle the load if direct-connected to a 3-phase generator. The speed, 170 rpm, is not a synchronous 60-cycle speed and will have to be changed to 200 rpm to match a 36-pole generator, or to 164 rpm for a 44-pole unit. The higher speed is preferable if the engines will stand the increase. Plant voltage should be 440 to save conductor copper and money on switches and control, although 220 v could be used. With either voltage, lighting and low-voltage motors can be supplied through transformers, either air or oil cooled. For the use contemplated, standard air-cooled transformers would be best. With 60-cycle 3-phase current, standby service from outside would be available. Direct current or some other frequency ac would introduce many disadvantages.

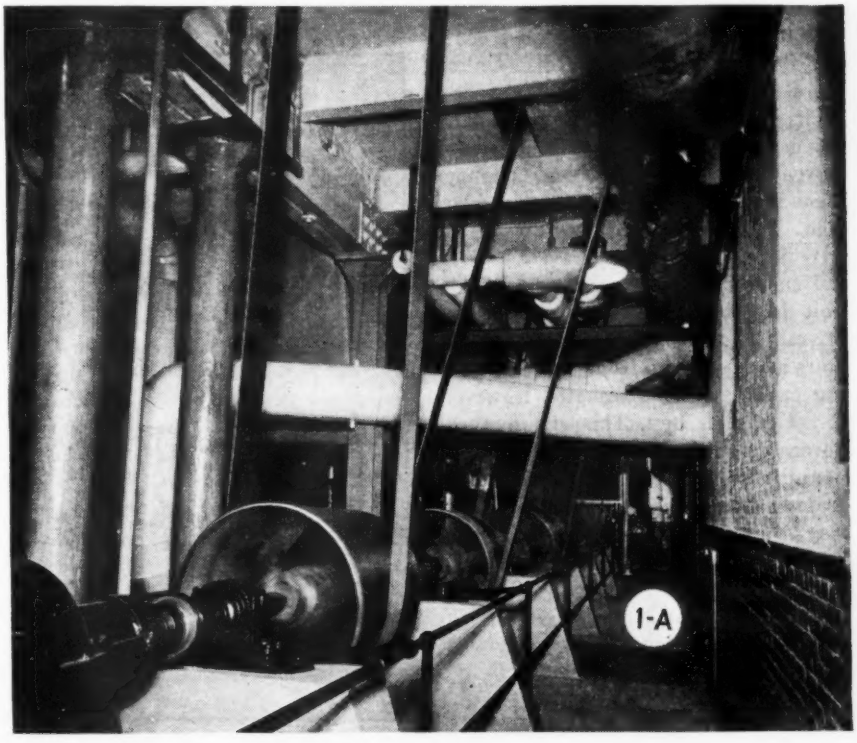
The motor load specified totals 360 hp or 277 kw, which requires a 350- or 360-kva generator. Exciter can be direct connected or driven by V-belts. Install modern voltage regulators together with a simple but rather complete switchboard. Board should have at least a minimum equipment which includes a main switch, ac ammeter, wattmeter (indicating), frequency meter and dc field ammeter and exciter rheostat.

An integrating watthour meter is valuable to determine the total kwhr generated, but is not essential. If standby service is obtained from outside, interlock the main switches so that the two sources could not be accidentally tied together.

If the plant lighting is needed when main generator is shut down secure this service from local utility or install a small engine or turbine-generator set.

It is possible to use belt drive for the generator if space and other considerations permit; here a much higher-speed and lower-cost generator can be used. But it would not be as satisfactory as a direct-connected machine.

The rating of the 20x20-in. engine is not given but I believe it can handle 277 kw. There would undoubtedly be a diversity factor—that is, the machines would not all operate at the same time



but in this plant the unit would have to carry the entire load when necessary. An overload for short periods would not prove troublesome. I realize the engine will operate close to its capacity but figuring the probable diversity factor it should be safe.

If investigation proves that the engine will not pull the load, the blower could be operated on purchased power. The constant load of the blower would be more attractive to the power company than any of the other equipment.

Carlsbad, N. M. E A ROBERTS

Power From Wood Waste

WHEN CONSIDERING power purchase, JDW should keep in mind his present fuel source. If shavings and sawdust cannot be processed or disposed of cheaply, it is economically sound to produce as much power as can be used from these byproducts. If enough of this fuel is available, do not purchase power.

The problem is one of multiple drive versus whole or partial conversion to unit drive by electric current generated in the plant. With belt maintenance high and resetting of some machines necessary, unit drive should be favorably considered, if for no other reason than that it is more flexible. One real advantage of multiple drive exists when a small engine or motor can drive a number of small machines having much larger total horsepower requirements, but with such intermittent operation that the combined load is never great enough to overload engine or motor.

From JDW's description, his plant possibly can operate at part capacity with the 18x18-in. 110-rpm engine; leaving the 20x20-in. engine idle. Unless there are unmentioned disadvantages, such as close tolerance between machines driven by one engine and those driven by another, this plant arrangement is ideal for remodeling or conversion. Production need be interrupted only in part.

I suggest that he convert entirely to unit drive by connecting ac generators directly to the engines. Or, the generators may be driven from the same driving pulleys as the lineshafts. However, direct drive is best. This and flywheel governors with synchronizing motors permit parallel operation of engine generators when necessary. Engine speed may be altered, with manufacturer's consent, to facilitate keeping the frequencies in step. Speed of the 18x18-in. engine might possibly be raised to 125 rpm, and that of the 20x20-in. reduced to this figure.

Marissa, Ill. GEORGE HOLMAN

Warrants Unit Drive

TO DEVELOP 270 hp No. 1 engine must have a mep of 100 psi. As boiler pressure is only 150 psi steam consumption per horsepower of this unit is abnormally high. However if the exhaust is used for process or heating this may be justified because fuel for these boilers apparently consists of wood refuse, costing only the labor and maintenance involved.

Assuming No. 2 engine also has a mep of 100 psi it develops 520 hp. Therefore there is ample power in the two prime movers to warrant their continued service, estimated motor requirements being only 400 hp.

Solution is to put both engines in first-class mechanical condition and use them in the new layout. Line up and level the woodworking machines and repair the foundations. Arrange them to run in sequence of plant operation to insure a minimum of manual materials handling throughout the mill.

Install a 500-kw 2300-v ac generator for direct drive by the larger engine and a 200-kw one connected to the smaller unit. Arrange electrical connections to operate in parallel through a transformer, to step the current down to 440 and 220 v. Also fit each woodworking machine with an individual motor drive.

The larger generator will be able to carry the normal load. Smaller one can be used at any time the load demands or when it is not economical to run the larger unit.

Use synchronous motors on the 50-hp drive. These will hold the power factor at a reasonable figure. Smaller motors may be induction units. Use of ac is obvious when one considers the advantages of this type of equipment. Elimination of shafting, pulleys, belts and low cost of maintenance of this drive soon pays off the investment to modernize this plant.

Where shaft speeds are suitable motors may be direct connected; if slower speeds are demanded use multi-grooved pulleys and V-belts.

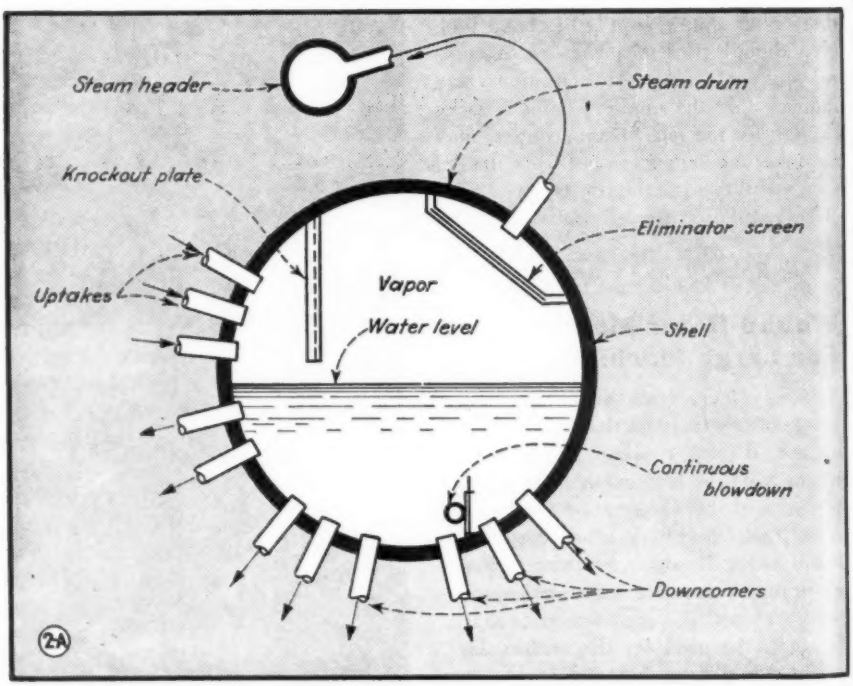
Kearny, N. J. GEORGE MCNALLY

Does Blowdown From Boiler Contain Steam?

(This is Question 2 from the March issue, with best answers from readers.)

WHAT IS *the actual loss in Btu per pound of effluent discharged as boiler blow-down? Some engineers claim that the discharge contains not only water at boiler temperature but also an appreciable quantity of steam bubbles representing latent heat required for actual evaporation.*

Possibly boiler design, pressure, circulation and rating may influence amount of steam assumed to be ejected with blowdown water. If the discharge contains no steam how do you determine what percentage of water flashes to steam and the quantity and temperature of the remaining water?—MFR



Explains Surface Blowdown

UPTAKE TUBES in a boiler discharge a mixture of saturated steam and saturated water into the steam drum above the water line. To separate the saturated vapor from its liquid, knock-out plates are so located that the mixture impinges upon them and the liquid drops to the water below. The vapor leaves and fills the steam space above the liquid, sketch 2-A.

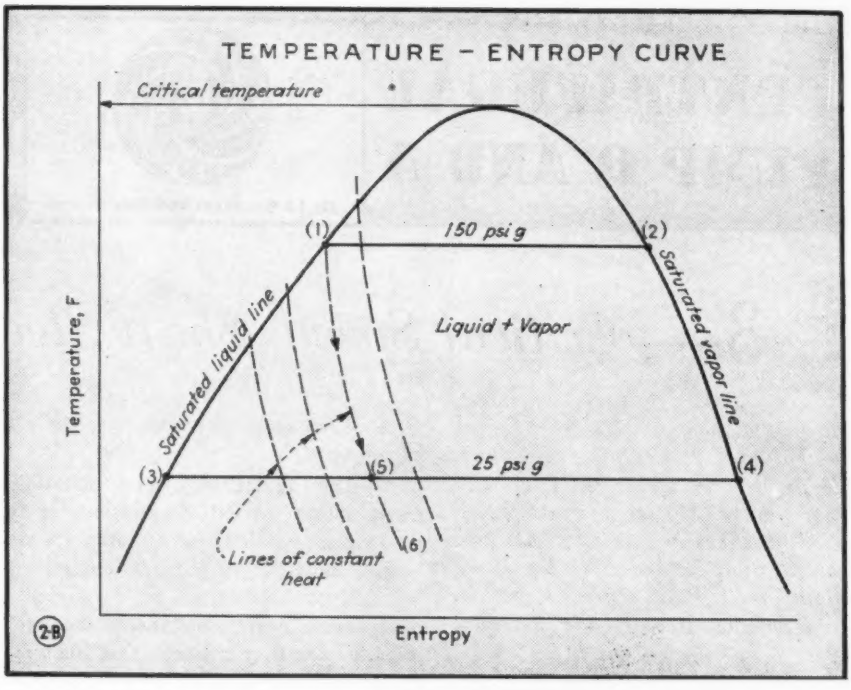
During periods of full load, turbulence created by the action of steam vapor and water entering the steam drum sets up a condition wherein both water and vapor are mixed intimately and are in equilibrium with each other. Under these conditions transfer of heat energy is taking place between both phases. Expressed simply, heat lost to the liquid by the vapor is returned just as rapidly by the liquid to the vapor. Except for heat lost to surrounding areas we could assume that the exchange is a constant heat process.

However, this turbulent condition exists only in the top layers of the main liquid body in the steam drum. From this it may be seen that if a continuous blowdown connection is taken from these top layers, steam in equilibrium with its liquid would be discharged. The depth to which this condition would penetrate depends on (1) steam-drum design (2) surface area exposed to the space above (3) turbulence resulting from boiler loading (4) depth of water in the drum.

Generally, the continuous blowdown connection is taken from a point well below this turbulent area and near the drum bottom. Here, too, total dissolved-solids content is greatest. If this arrangement is set up, no appreciable amount of enveloped vapor will be discharged from the system and the heat of the water alone may be considered wasted.

Under certain conditions, depending on usage, part of the blowdown water may flash into steam at pressures lower than that in the boiler. Steam so flashed can be sent to a feedwater or space heater, or used in any other manner. This steam is not appreciably contaminated after it has evaporated from the blowdown water.

The blowdown water may be considered as saturated and, for purposes of illustration, at 150 psig. Suppose the water is then flashed in a space maintained at 25 psig. Amount of water flashed depends on the pressure in the flash space. The lower this pressure the greater the amount of steam flashed per unit weight of blowdown water.



The skeleton temperature-entropy diagram, sketch 2-B, illustrates the process through which one pound of saturated water at the previously mentioned conditions will pass and be flashed. Point 1 represents the condition at which the water leaves the steam drum in a saturated condition at 150 psig; and, except for pressure drop in the blowdown piping, may be considered to remain substantially the same. This point lies on the *saturated liquid line.*

Point 2 indicates saturated steam, or that point where the last drop of water is evaporated into steam saturated at those conditions. The area under the curve is one where both liquid and vapor under saturated conditions exist simultaneously. Line 1-2 is the constant pressure line at 150 psig and is parallel to the base of the curve. Any point along line 1-2 represents so much saturated water and so much saturated steam at a pressure of 150 psig. Points 3 and 4 and line 3-4 represent the same conditions but at a pressure of 25 psig. Line 1-6 and the other lines running parallel to it are constant heat lines. For this illustration we will consider only line 1-6.

Since flashing of water under these conditions is considered a constant heat process, the mechanism of flashing lies along line 1-6. Point 5, where line 1-6 crosses the 25-psig line, indicates the amount of water and steam remaining after the flashing process. These are the amounts we will now calculate.

Neglecting radiation and striking a heat balance across the system undergoing the changes: Heat in saturated water = heat in vapor flashed + heat of water at the expanded state. This is true since it represents a constant heat process.

From the steam tables: (1) Heat in saturated water at 150 psig is 338.53 Btu per lb. (2) Heat in saturated steam at 25 psig is 1169.7 Btu per lb. (3) Heat in saturated water at 25 psig is 236.02 Btu per lb. Let X equal the weight of water flashed into steam at 25 psig and assume 1 lb of water as a basis.

Then: $338.53 \times 1 = (1169.7X) + [236.02 \times (1 - X)]$. Solving for X, we find it equals 0.1096 lb. This is the amount of the original pound of saturated water at 150 psig which has flashed into steam at 25 psig. Therefore $1 - 0.1096$, or 0.8904 lb of the original water remains as water at 25 psig. For every pound of water flashed, 0.1096 lb goes off as steam.

Cliffside Park, N. J. J D CONSTANCE

Steam Escapes Under Some Conditions

IT IS CONCEIVABLE that in blowing down a boiler, quantities of steam bubbles may be released which represent latent heat of evaporation. I believe it to be particularly true when boilers are blown down while under load, except for some watertube units in which the mud drum has little or no direct heating surface, and does not have forced circulation.

Where load conditions justify a banking period, the accepted practice is to blow down at the end of the banking period, just prior to picking up load. Since no appreciable heat would be

(*Continued on page* 136)

CENTRIFUGAL PUMP Q AND A FOR POWER ENGINEERS

By I J Karassik and Roy Carter

3—*Critical Speed, Shaft Sleeves and Seals*

Third in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—*What is dynamic balance?*

A—A pump rotor is in dynamic balance if all the various centrifugal forces resulting from its rotation balance each other. Such a rotor runs at full speed without vibration.

Q 2—*What is static balance?*

A—A pump rotor is in static balance if, when supported on parallel and level knife edges, or their equivalent, it will remain stationary in any position in which it may be placed.

Q 3—*What is the critical speed of a pump shaft?*

A—Any object of elastic material has a natural period of vibration. If a pump rotor or shaft rotates at a speed corresponding to its natural frequency, any minor unbalance is magnified. Such speeds are critical speeds. Lowest is called the first critical; next higher, the second, etc. A centrifugal pump's rotor operating at its critical speeds vibrates excessively, its shaft deflections exceed internal clearances and the shaft fails.

Q 4—*What is the relationship between critical speed of a pump shaft and its operating speed?*

A—Generally, shaft dimensions of a single-stage pump cause the first critical speed to be considerably above its operating speed. However, centrifugal pumps may operate above their first critical speed without danger if the speed is high enough. This is done in multi-stage pumps by designing their shafts so that the first critical speed is from 60 to 75% of the operating speed.

Q 5—*What is meant by rigid and flexible shafts?*

A—A rigid shaft has a first critical speed higher than its operating speed. A flexible shaft has its operating speed higher than its critical.

Q 6—*What is the function of a shaft sleeve?*

A—A shaft sleeve, Fig. 1, protects the shaft, thus preventing corrosion, erosion and wear from affecting its strength. Many forms are used in centrifugal pumps; the commonest protects the shaft against wear where it

(*Continued on page* 116)

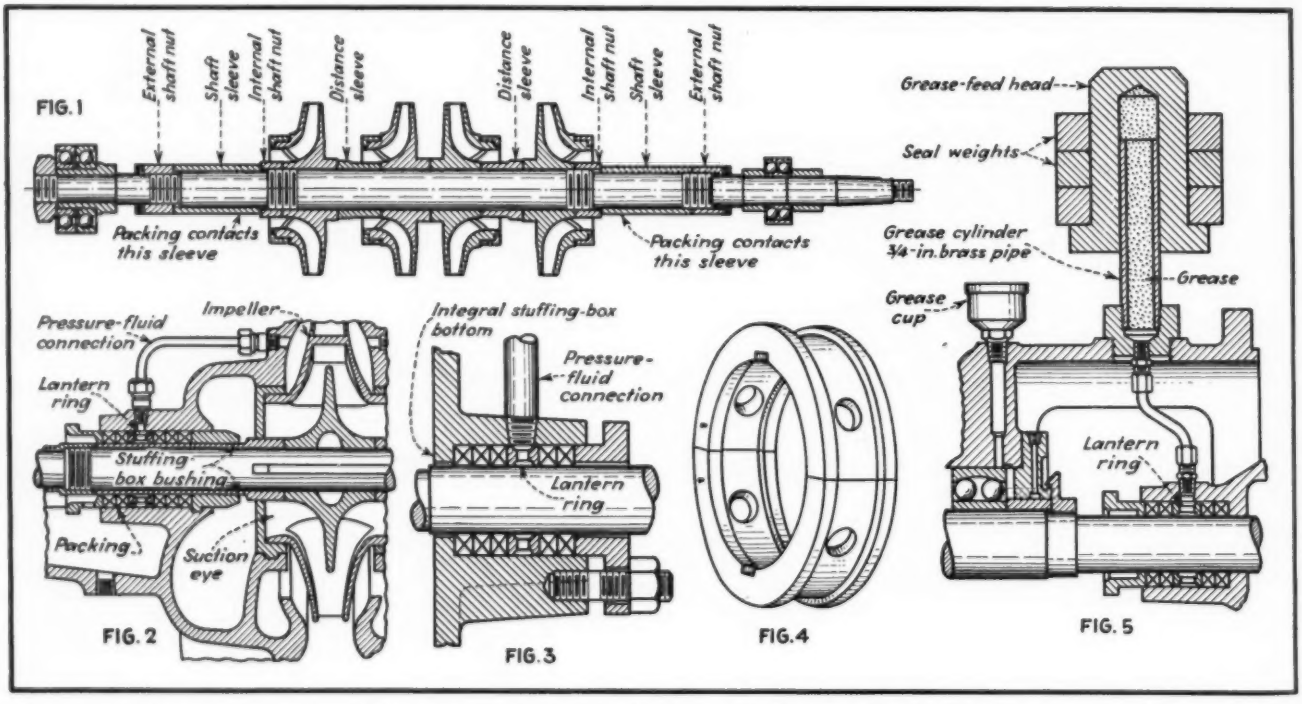


Fig. 1—Shaft sleeve protects shaft from corrosion and wear. Fig. 2—Lantern ring connected to a source of pressure liquid helps to seal the stuffing box. Fig. 3—Stuffing-box section with lantern ring but without stuffing-box bushing, as in Fig. 2. Fig. 4—Stuffing-box seal or lantern ring. Fig. 5—Typical arrangement of weight-loaded grease sealer connected to lantern ring in stuffing box, often used on chemical pumps to avoid dilution

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PUMP Q AND A

(*Continued from page* 114)

extends through the stuffing box. On small pumps a shaft sleeve may increase the shaft outside diameter to where it seriously reduces the impeller suction area and increases hydraulic and stuffing-box losses. Because of this, small pumps are frequently built with stainless-steel shafts, sufficiently corrosion-and-wear resistant to operate satisfactorily without a sleeve.

Q 7—*What is a distance sleeve?*

A—It is a sleeve, Fig. 1, that protects the shaft between impellers of a multi-stage pump. In some designs, impellers have long hubs that make distance sleeves unnecessary.

Q 8—*What is the purpose of a stuffing box?*

A—When pressure at its inner end is below atmospheric, the stuffing box prevents air leakage into the pump. When pressure at its inner end is above atmospheric, the stuffing box prevents liquid leaking out of pump.

Q 9—*What is a stuffing-box bushing?*

A—It is a removable piece that forms the stuffing-box bottom in some smaller sizes of centrifugal pumps, Fig. 2. It is not split even though the pump casing in which it fits is split axially and is generally held from rotation by a locked tongue-and-groove joint in the lower half of the casing. On large pumps stuffing-box bushings are rarely used, Fig. 3. Use of stuffing-box throat bushings is based mainly on manufacturing consideration rather than on any particular operating advantage. They generally are used in small pumps, in which the diameter of an integral stuffing-box bottom would limit the boring-bar size to too small a diameter.

Q 10—*What is the purpose of a stuffing-box seal or lantern ring?*

A—To prevent air leakage into the pump when operating on a suction lift, a water-seal cage or lantern ring, Fig. 4, is fitted into the stuffing box. Fig. 2 and 3. Water or sealing fluid under pressure piped to the space provided by the lantern ring, Fig. 2, makes an effective seal beyond which air cannot pass into the pump. This seal chamber also provides a reservoir of water or fluid for cooling and lubricating the packing. A seal may also prevent inflammable or chemically active and dangerous liquids flowing out to the atmosphere.

Q 11—*When is an independent sealing liquid needed in a lantern ring?*

A—When a pump handles clean, cool water, stuffing-box seals usually connect to the pump discharge, Fig. 2, or to an intermediate stage. Provide an independent water-sealing supply when: (1) suction lift exceeds 15 ft (2) discharge pressure is less than about 10 lb or 23-ft head (3) pump handles hot water (over 250 F) and adequate cooling is not otherwise provided (4) water is muddy, sandy or gritty (5) pump in hotwell service (6) acids, juices, molasses or liquids other than water are handled, with no special provision in

(*Continued on page* 118)

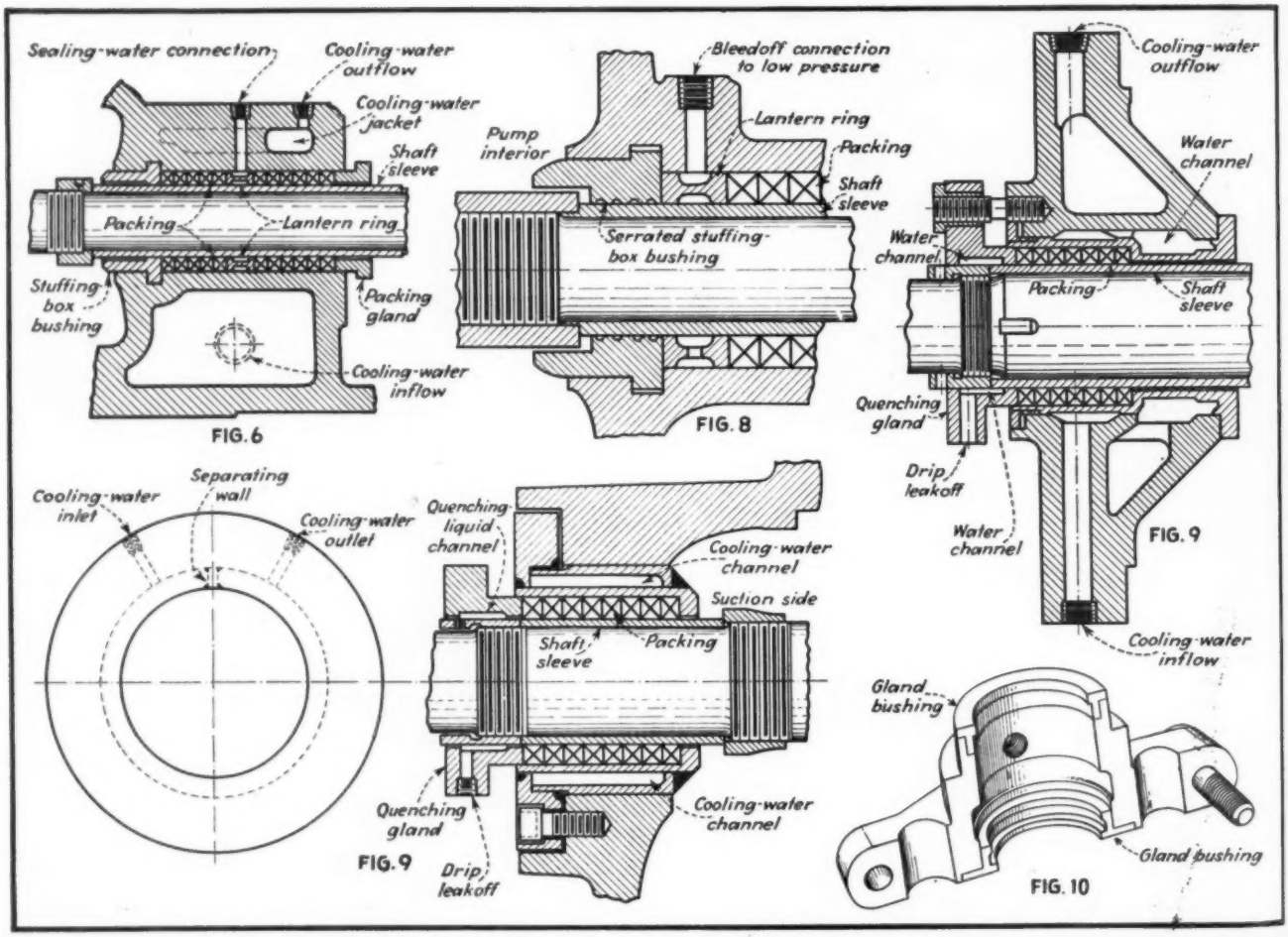
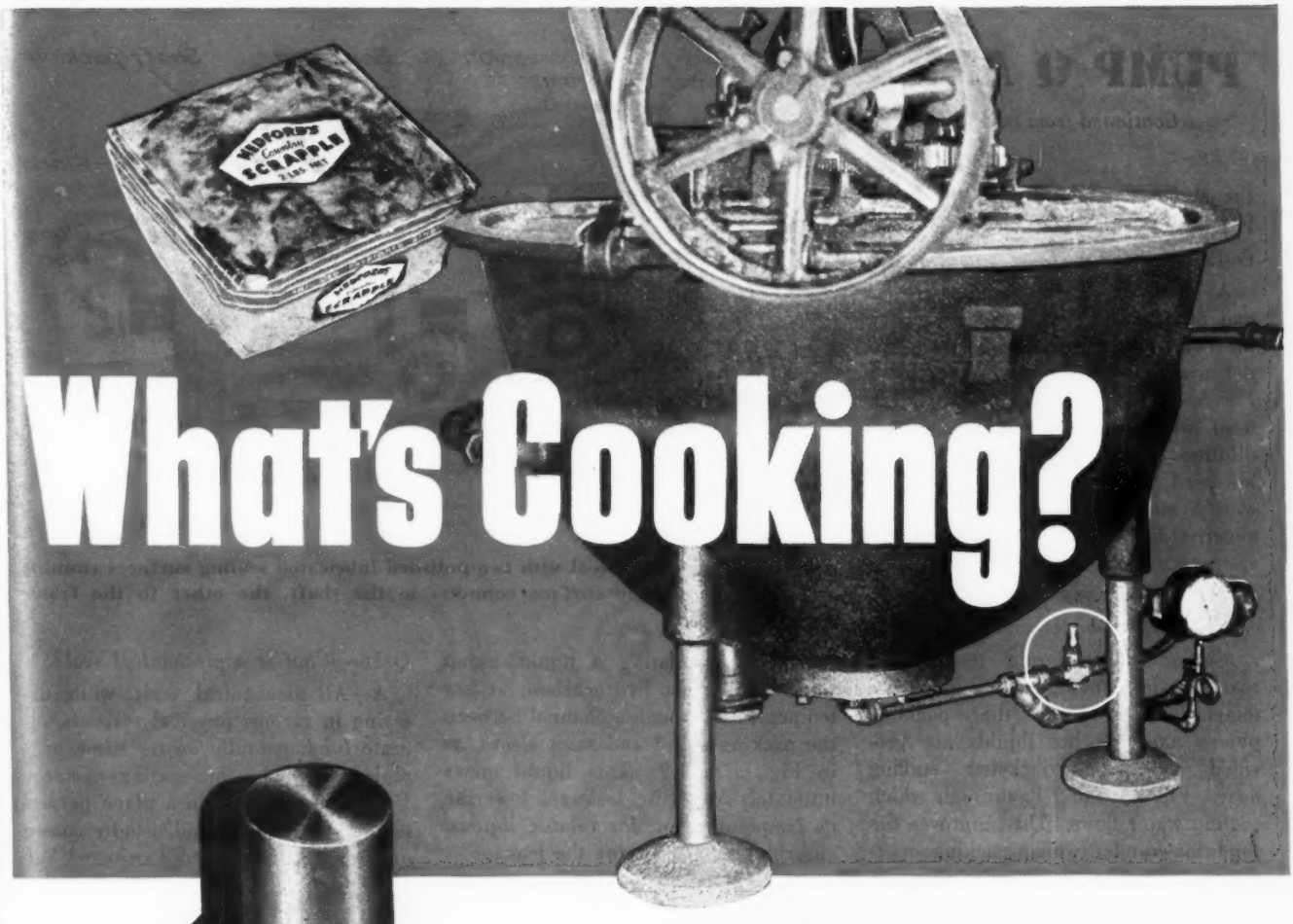


Fig. 6—Integral watercooled stuffing box for high-temperature liquids. Fig. 7—Separate watercooled stuffing box with drip leakoff in packing gland. Fig. 8—Pressure-reducing stuffing-box bushing used on pumps with high pressures on their suctions. Fig. 9—Improved watercooled stuffing box with drip leakoff for high-suction pressure and temperature. Fig. 10—Half of a split gland with internal bushings made of nonsparking material, bronze



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YARWAY IMPULSE STEAM TRAP

PUMP Q AND A

(*Continued from page* 116)

the stuffing-box design for the liquid pumped.

Q 12—*When is a grease seal used?*

A—It is used for intermittent service and other duties when water or other clear liquids cannot be used or are not available. Weight grease sealers. Fig. 5, are available and are frequently used with chemical pumps to avoid dilution. They are frequently used on low-head drainage pumps operating with a suction lift and often with a negative discharge pressure on a siphon system.

Q 13—*What is the purpose of water-cooling stuffing boxes?*

A—To reduce liquid temperature reaching the packing and to lower the temperature around the packing, pumps handling hot liquids are provided with water-jacketed stuffing boxes, Fig. 6, 7 and 9, through which cooling water flows. This improves the conditions under which packing operates.

Q 14—*What is a smothering or quenching gland and where is it used?*

A—In many pump applications, stuffing-box leakage to the atmosphere is objectionable because it would create an explosion hazard or be dangerous to personnel. This is frequently true of pumps handling hydrocarbons, at temperatures above their flashpoint or vaporizing temperatures. When leakage cannot be cooled sufficiently by the watercooled stuffing box, provision is made for circulating a liquid, either water or another hydrocarbon, at low temperature through a channel between the packing gland and shaft sleeve, as in Fig. 7 and 9. This liquid mixes intimately with the leakage, lowering its temperature or, for volatile liquids, absorbing or smothering the leakage.

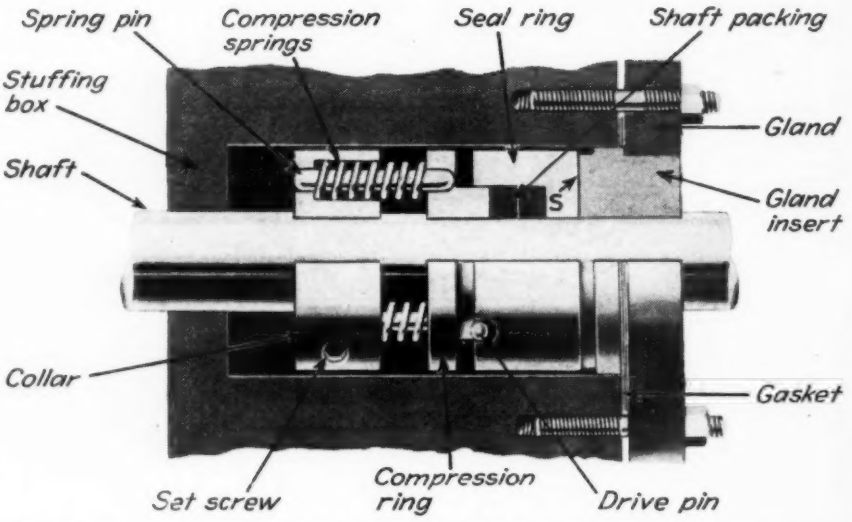

Fig. 11—Stuffing-box seal with two polished lubricated sealing surfaces running on each other. One surface connects to the shaft, the other to the frame

Q 15—*What is a stuffing-box pressure-reducing device?*

A—When pressures exceed a value against which the stuffing box can be safely packed, a pressure-reducing device may be provided. Essentially it consists of a bushing, Fig. 8, or a meshing labyrinth located between the pump interior and the stuffing box proper, ending in a relief chamber. The latter is connected to a region of lower pressure and leakage past the pressure-reducer returned to this point.

Q 16—*What is a mechanical seal?*

A—All mechanical seals, while differing in various physical respects, operate fundamentally on the same principle. In each, the sealing surfaces, Fig. 11, are located in a plane perpendicular to the shaft and usually consist of two highly polished lubricated surfaces running on each other, at *S*, one surface being connected to the shaft and the other to the frame. The polished or lapped surfaces of dissimilar materials are held in continual contact by springs. The surfaces form a fluid-tight seal between rotating and stationary members with small frictional losses. In Fig. 12 a mechanical seal is installed on each side of the impeller at *S*.

Q 17—*Why are mechanical stuffing-box seals used?*

A—For many service conditions a conventional stuffing box with composition packing is impracticable for sealing a rotating shaft, particularly where the seal must be leakproof. A mechanical seal provides a leakproof design with low-power losses for a wide range of fluids, such as corrosive acids and gritty, or inflammable liquids.

Q 18—*What is a split gland and when is it used?*

A—Split glands are made in halves so that they can be removed from the shaft without dismantling the pump, to allow more working space during repacking. Their halves are generally held together by the gland bolts or separate bolts, but other designs are also used. Fig. 10 shows one half of a split gland that is held together by separate bolts.

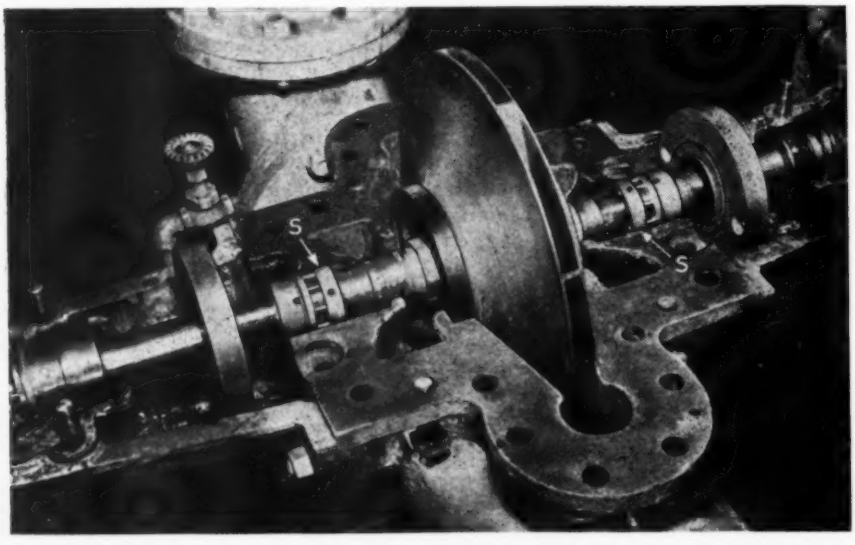

Fig. 12—Stuffing-box seals, Fig. 11, on impeller shaft at *S* form a fluid-tight seal between rotating and stationary members with low friction losses

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REFRIGERATION NOTEBOOK — 21

Hunting Leaks in CO_2 Refrigeration Systems

By TERRY MITCHELL, ME, *Frick Company*

AN ENGINEER recently wrote: "As a subscriber to POWER and a reader of your "Refrigeration Notebook," I am prompted to ask your assistance.

"I am in charge of a 3-stage CO_2 refrigeration plant, used to cool air to minus 50 or 60 F. I am familiar with the difficulty encountered in "holding CO_2" and the difficulty also in detecting a leak.

"Although a thorough and painstaking examination for leaks was conducted and despite the fact that none were found, I am sure my CO_2 loss is much too high. In fact, in a year it would be equal to several times the 50% allowable loss. Perhaps it is the condition of operation. We operate during the year under the following conditions: (1) continuous operation 24 hours per day, six days a week; defrosting over the weekend (2) operation only a few days a week (3) operation a few days a month. It seems that the longer the plant is inactive, the greater the loss in CO_2.

"Compressors are vertical, semi-inclosed, single acting, and are belt driven by electric motors. Stages are divided as follows: First stage uses a water spray to cool the air to 40 F; 2nd stage uses a brine spray to cool it to 0 F; 3rd stage has direct-expansion coils and cools it to minus 50 F (see sketch). Condensing water temperature averages 55 F.

"If you have any suggestions or literature that will help me reduce this large CO_2 loss, or at least locate the trouble, it will be greatly appreciated."

The request was answered in this manner, and the advice proved helpful: Places where leaks are likely to occur are pipe joints, valve stems, shaft or piston packing, cover gaskets, pipe bends, or at inter-coolers. Intermittent operation probably aggravates the tendency to leak, as the pressure rises in the low side during shutdown periods and there is also a loosening effect from expansion and contraction caused by changing temperatures.

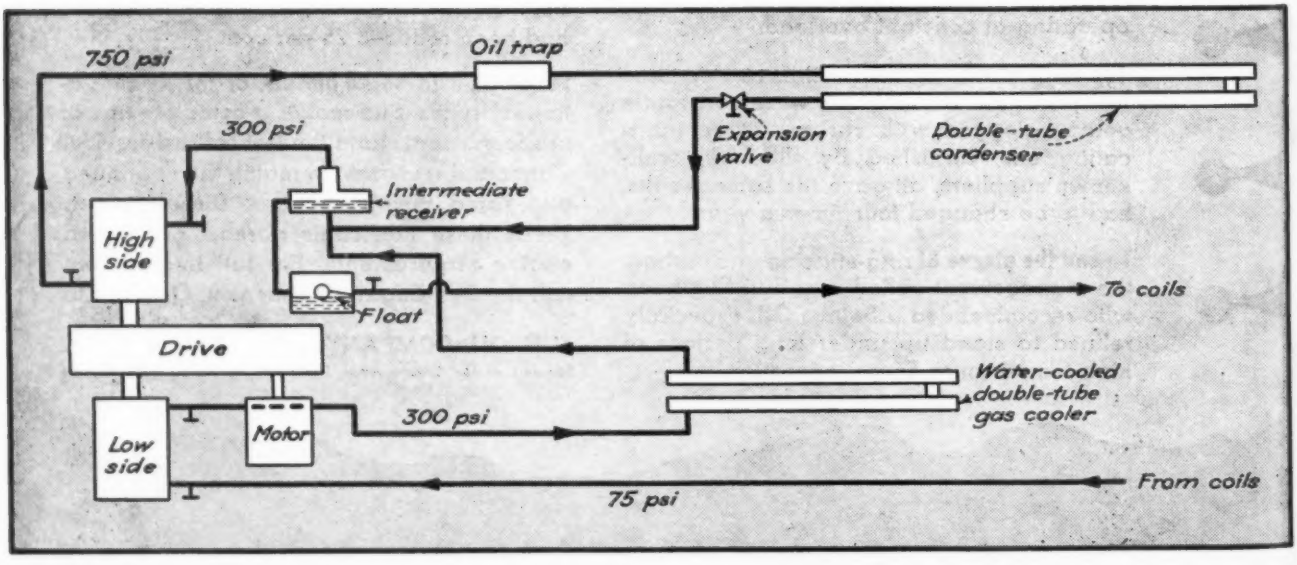
If water has entered the system it may have reacted with the CO_2 to form carbonic acid, which eats pinholes in the piping, particularly at bends or other points normally strained or thinned out, as at pipe threads. If you are unable to detect these leaks with soap bubbles or by sound, you might find them by adding oil of peppermint to the gas charge. Introduce it by a pump through the charging connection; or possibly through the oiling system.

As you searched with care and were unable to find any leaks I believe they are in the condensers, one of the inter-coolers, compressor jackets, or other places where water has a chance to absorb the escaping gas. If the water is cold it absorbs a greater quantity of gas without being noticed. It may be necessary to remove the water heads or drain the jackets and disconnect the piping to test for such leaks; this you can do in shutdown periods.

Another thing that causes excessive leakage is the presence of air in the system. If repeated repairs have allowed air to enter the piping, pressures are higher than necessary and operation tends to be uneven. Excessive oil in the piping has a somewhat similar effect.

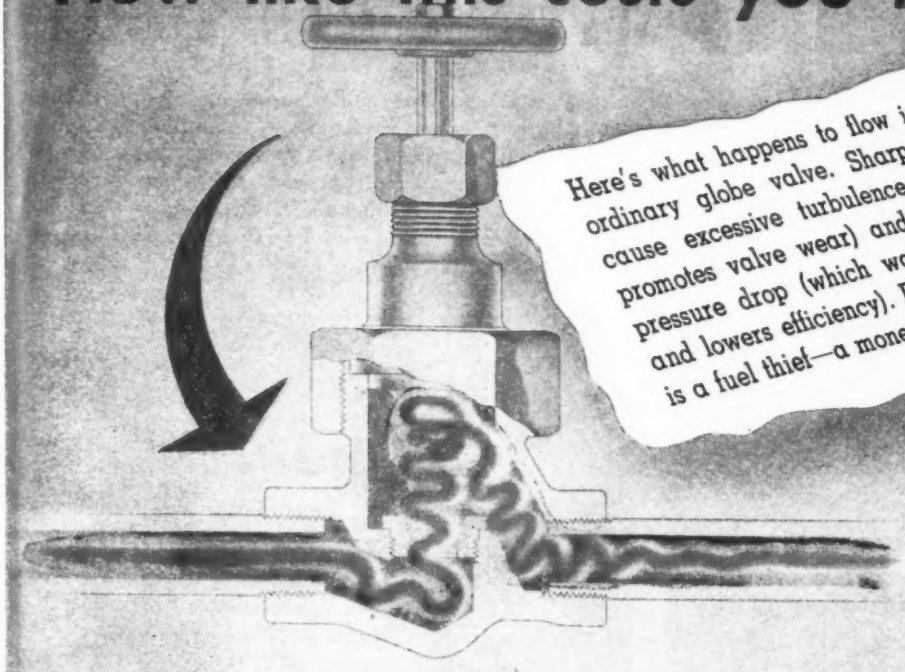
Correction

In "Kobuta Plant Licks Problems of 65% Makeup and 10-40% Blowdown" (POWER, *Feb*, 1945) *in the plant-equipment table on page 66 under Coal-Handling equipment, the coal crusher was furnished by American Pulverizer Company, not by Pennsylvania Crusher Company, as listed.*



Refrigeration plant that cools air to minus 50 or 60 F by using (1) water spray to cool air to 40 F (2) brine spray to cool it to 0 F and (3) CO_2 direct-expansion coils to reduce temperature to the final value required

Flow like this costs you money . . .



Here's what happens to flow in an ordinary globe valve. Sharp turns cause excessive turbulence (which promotes valve wear) and increase pressure drop (which wastes power and lowers efficiency). Flow like this is a fuel thief—a money waster!

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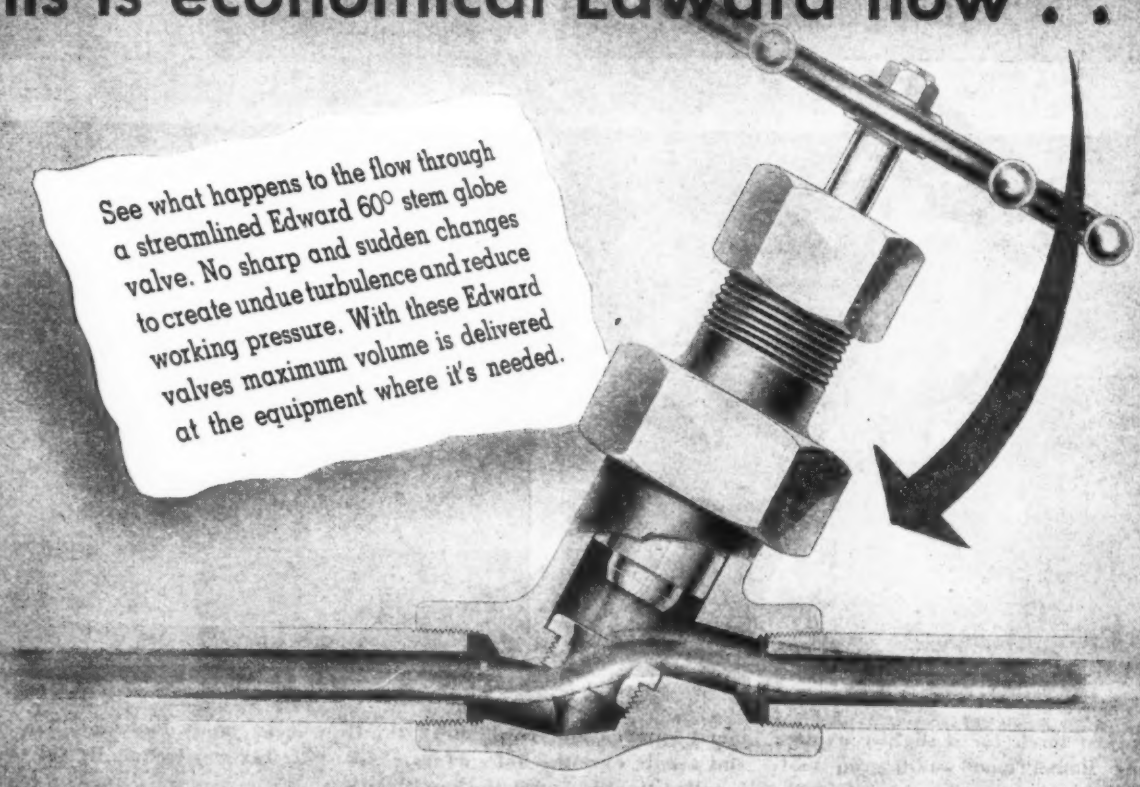
See what happens to the flow through a streamlined Edward 60° stem globe valve. No sharp and sudden changes to create undue turbulence and reduce working pressure. With these Edward valves maximum volume is delivered at the equipment where it's needed.



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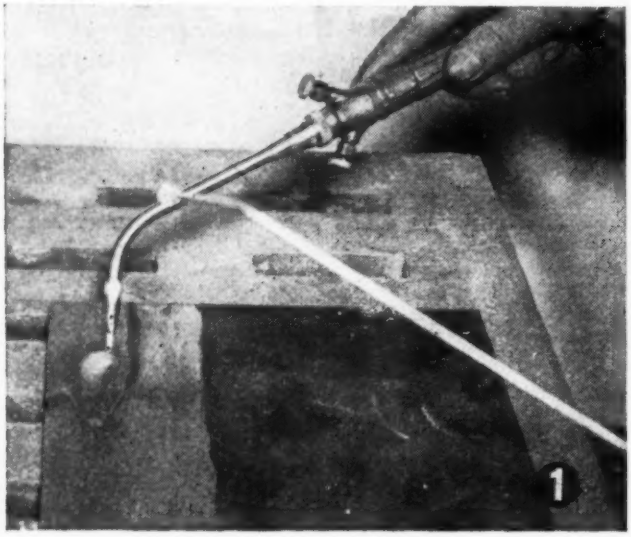
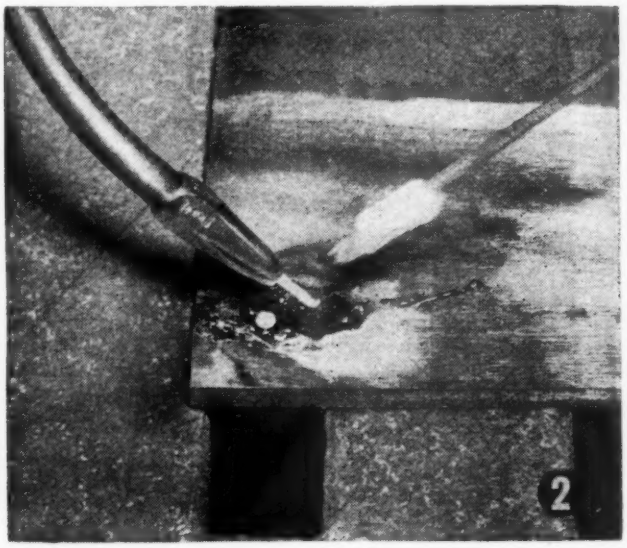
HOW TO BRONZE-WELD STEEL WITH A GAS TORCH

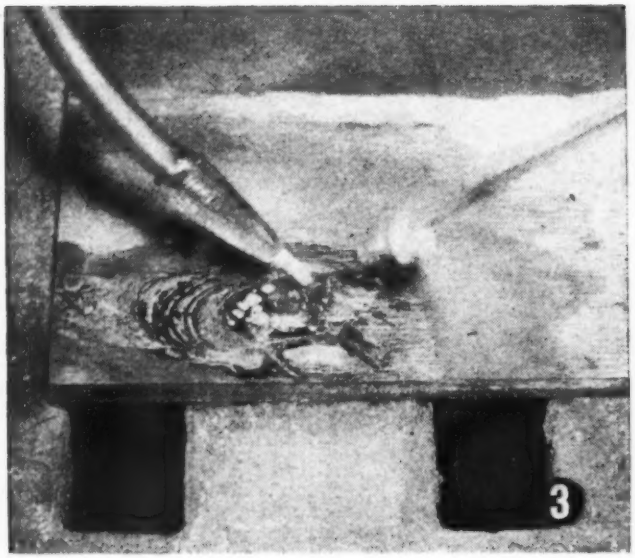
WHEN BRONZE-WELDING steel, cast iron and malleable iron, the base metal instead of being melted is merely made hot enough to bond with the bronze (a bright red color in the dark).

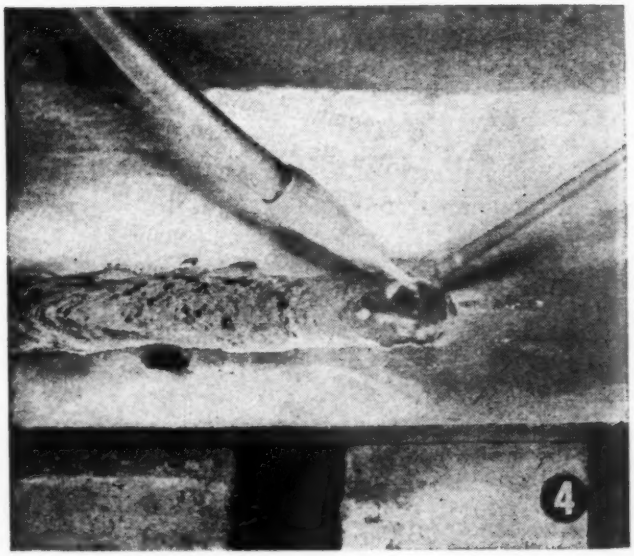
To make a good strong bond the pieces of base metal must be tinned, that is, they must be thoroughly cleaned and heated so that the bronze flows evenly over and wets the entire surface. Clean metal and good flux are essential to a good tinning job.

Because bronze-welding requires relatively low heat, it is ideal for joining dissimilar metals and welding heat-treated parts. It simplifies the welding of cast iron since preheating is often not required; but when necessary, preheating need not extend beyond a black heat (900 F). *Courtesy, The Linde Air Products Co*







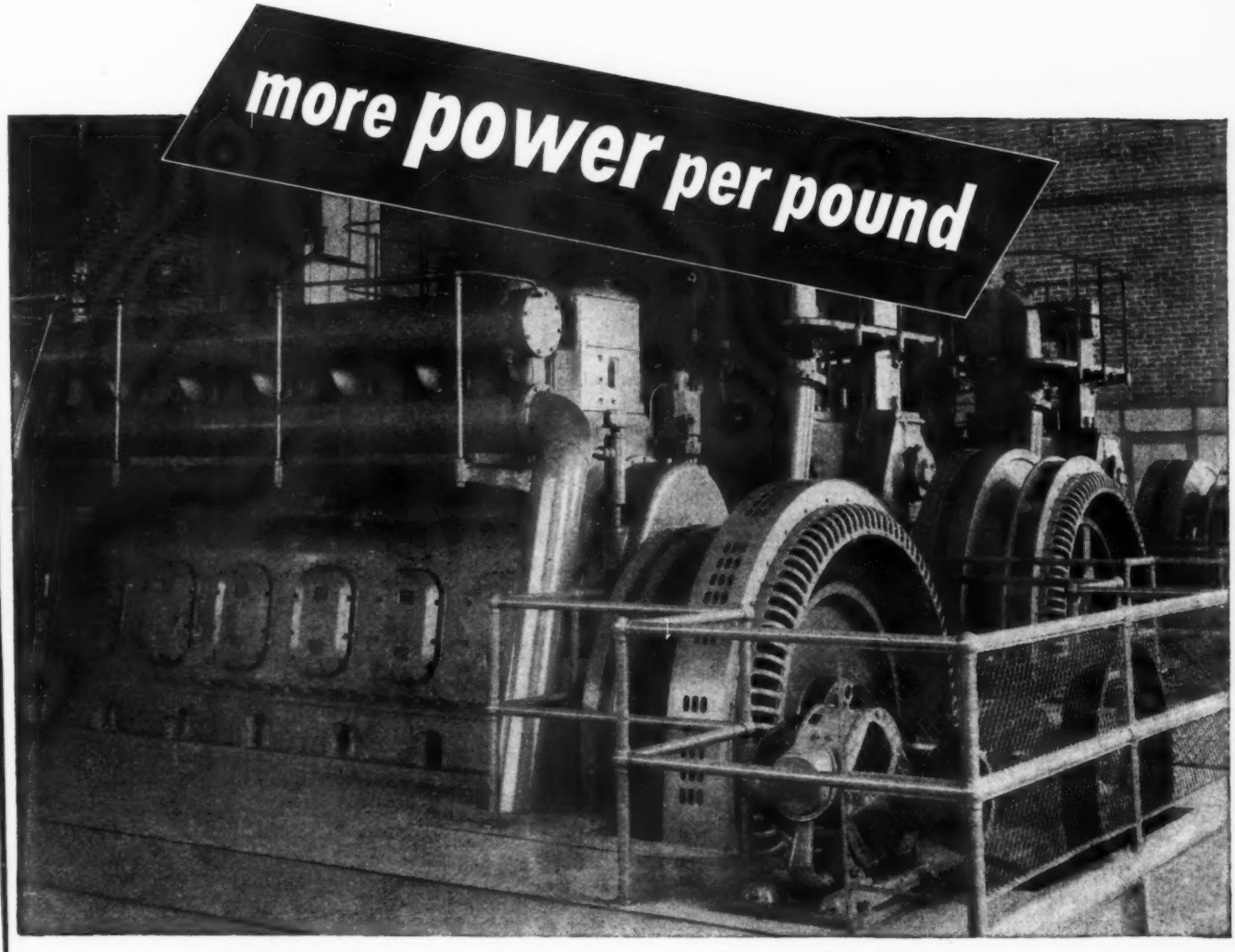


1 Adjust torch for a slightly oxidizing flame, heat welding-rod end and dip into flux (have rod hot enough to pick up flux). Heat 2-sq-in. patch of base metal along weld line to a blue color. Then at starting point heat a dime-sized spot to a bright red.

2 Next melt the fluxed end of rod on the red-hot area so that the metal spreads and runs ahead thinly and evenly over the hot surface. This is called tinning and is the small, dark area under and ahead of the flame.

3 Tin the surface with a thin layer of bronze in strips ¾ in. wide. Caution: If base metal is too hot, zinc in the rod burns out and tinning is spotty; if too cold, rod metal becomes sticky and does not flow smoothly. Reflux rod frequently for best results.

4 After tinning the areas to be welded, deposit layers of bronze about ⅛ in. thick and ¾ in. wide until proper thickness is obtained. Alternately dip and raise rod from puddle so that the flame gets under the rod and the metal flows out ahead.



ONE of the important achievements of Baldwin engineering

The picture tells the story of one important Baldwin development. The Baldwin Diesel in the foreground generates almost as much power single-handed as the *two* larger diesels in the background: 500 kw. as against a combined output of 540 kw

The Baldwin VM Diesel incorporates every successful advance in 4-cycle diesel design, while providing an economical, compact, highly efficient unit that requires a less expensive generator than low-speed engines, demands a smaller foundation, and can be housed in a smaller engine-room. It offers real profit possibilities to plants requiring dependable, low-cost power in a 500-1000 hp package. The special injection-combustion system makes the engine less sensitive to variation in fuel oils. All moving parts are enclosed, but are easily accessible.

The comprehensive line of Baldwin Diesels includes a type to fit each need. Talk to a Baldwin representative before you buy. The Baldwin Locomotive Works, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston, Pittsburgh, Detroit.

BALDWIN PRODUCTS

Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

BLW THE BALDWIN GROUP

BALDWIN

DIESEL ENGINES

THE ARGUMENT CORNER

Use of Amines In Steam Systems

WE WERE INTERESTED in your publication (POWER, March, 1945, p 71) of an abstract of Bureau of Mines Bulletin No. R I 3754, "Observations on the Use of Cyclohexylamine in Steam-Heating Systems."

It should be pointed out, as referred to on page two of the bulletin, that the application of volatile organic amines to steam systems is covered by U. S. Patent No. 2053024, issued Sept 1, 1936, and assigned to Western Chemical Co, Kansas City, Mo. This process can be used without infringement only by licensees or sub-licensees of the Western Chemical Co under this patent.

May we also comment on the bulletin itself? A proper evaluation of the work reported must take account of the limited objective of this particular investigation.

The report admittedly covers first findings only, and the tests made were tentative in character. The chief value of the results secured is that they point the way to the procedure and controls that should be maintained to bring out the full efficiency of the process.

WESTERN CHEMICAL CO
M E Dreyfus, Vice-president

Pulverized-Coal Firing Suggestions

IT IS NOT POSSIBLE to suggest detailed safety rules without knowing more about the coal and pulverizer (Reader's Problems, Jan., 1945, POWER). When one mill serves more than one boiler, each branch pipe must be fitted with a positive shutoff valve in addition to dampers or distributors that distribute coal to the various boilers. Assuming that FCL's mills are negative pressure units with an exhauster fan on the discharge side, here is a general set of rules for lighting off:

(1) Close secondary air vanes on all burners, or windboxes.

(2) Start induced-draft fan (or open uptake damper for natural draft) and maintain a furnace draft of about 0.10 in. water.

(3) Start forced-draft fan.

(4) Insert lighted oil torches in burners.

(5) Start pulverizer and exhaust fan (if it is separately driven).

(6) Adjust primary-air damper for proper air flow. As a rich mixture is required, set the primary-air damper for minimum air without danger of choking the mill.

(7) Check furnace draft and readjust to 0.10 in.

(8) Start coal feeders and set controllers in operating position. This is usually about half maximum mill capacity.

(9) Generally at this point it is advisable to load the mill until choking is about to occur. Do this by reducing primary-air flow. Reduced primary-air does not completely exhaust the mill so watch the motor ammeter carefully; when current value indicates that choking is about to occur, open the primary-air damper gradually until ignition takes place. Then leave it in this position until fire burns steadily. Caution operators to keep away from observation ports because there may be a puff or flareback.

(10) If ignition fails, or fires go out, immediately: (A) Stop feeders. (B) Increase air flow to purge furnace. (C) Start lighting-off procedure once more.

Temperature of air entering the mill depends on the coal's moisture content. With sub-bituminous and lignite of high inherent moisture, entering-air temperature can be as high as 500 F. A mill exit temperature of 200 F is usually considered the maximum with these coals; if temperature exceeds this limit fireman opens the tempering damper on inlet side of mill.

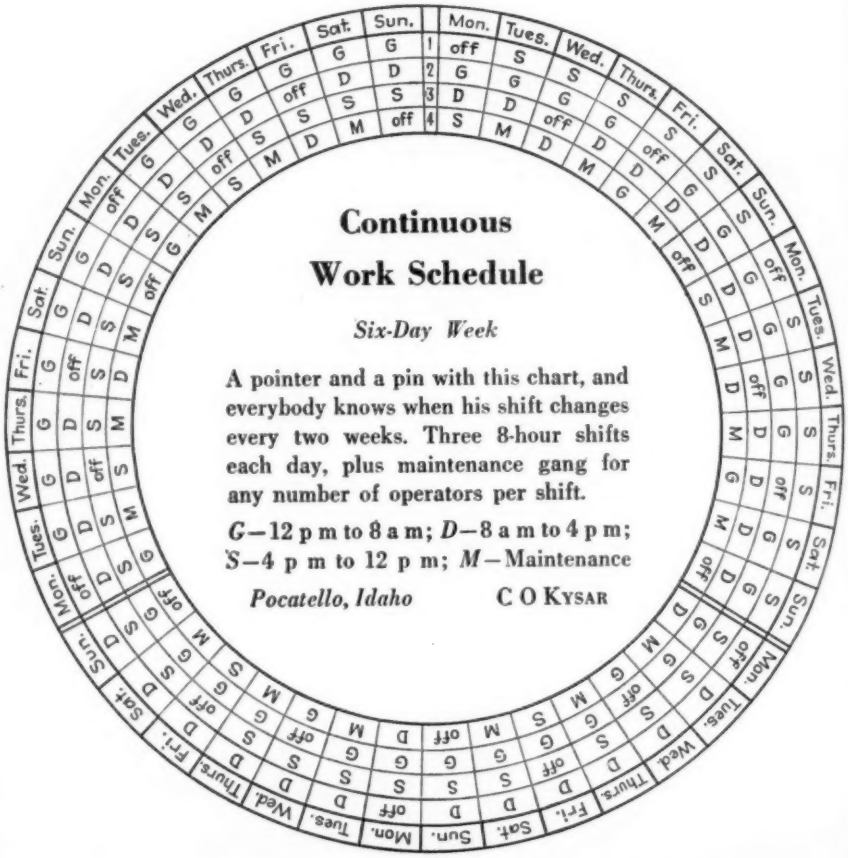
I have seen live coal, from spontaneous combustion in bunkers, fed to negative-pressure impact and bowl mills, and never were there fires or explosions.

One burner should never be lighted from another or from hot refractory since a violent puff might occur. always use an oil torch.

A R EASTCOTT
Princeton, B. C.

INDEX AVAILABLE

Copies of the index for 1944 POWER are available. Because of paper shortage, it will be impossible to make any general distribution but single copies may be obtained, while they last, by addressing Miss M Coffey, POWER, 330 West 42nd Street, New York 18, N. Y.


Continuous
Work Schedule
Six-Day Week
A pointer and a pin with this chart, and everybody knows when his shift changes every two weeks. Three 8-hour shifts each day, plus maintenance gang for any number of operators per shift.
G—12 p m to 8 a m; D—8 a m to 4 p m; S—4 p m to 12 p m; M—Maintenance
Pocatello, Idaho C O KYSAR

ARSENICAL ADMIRALTY CONDENSER TUBES

An improved alloy with high resistance to dezincification

NOT a "cure-all," but a tube alloy to consider if you are troubled with dezincification. The American Brass Company has been manufacturing Arsenical Admiralty Tubes on a commercial basis since 1934, and now furnishes this alloy as standard for Admiralty Tubes*.

This alloy was the result of studies of the effect of small quantities of arsenic introduced in brass alloys as an inhibitor of dezincification.

The consistently satisfactory performance of Arsenical Admiralty Tubes, over the past 11 years in many types of service has substantiated the results of laboratory tests.

While Anaconda Arsenical Admiralty Condenser Tubes have been quite generally used, they are especially well-adapted to those installations in which the older alloys showed definite tendencies to dezincify.

(At top) grating type spectrograph used to determine Arsenic content in Arsenical Admiralty Condenser Tubes. (Above) Densitometer-Comparator used to read spectra taken on the spectrograph.

TECHNICAL SERVICE AVAILABLE

It is a function of the engineers of our Technical Department to assist Condenser Tube users in the selection of the most economical tube alloy for any given set of operating conditions. Feel free to call on us. Publication B-2, sixth edition, giving detailed information on Condenser Tube and Tube Sheet Alloys mailed on request. 48322

**Admiralty Alloy Tubes without arsenic will be furnished only when so specified.*

ANACONDA **Anaconda Condenser Tubes**

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

KEEP FAITH WITH YOUR FIGHTERS AND YOURSELF! BUY WAR BONDS FOR KEEPS

What's New in Plant Equipment

Check Valves

OIC CAST-STEEL swing check valves, in 150- and 300-psi classes, are of full-way design in which disk completely clears waterway in wide-open position. Complete disk assembly is suspended from brackets inside body and is removable as a unit through cap opening. *Ohio Injector Co, Wadsworth, Ohio*

Hand Tachometers

TWO NEW TACHOMETERS have been added to line of *J* triple-range hand tachometers of centrifugal design. Catalog No. 1412 combines in one instrument all speeds from 100 to 12,000 rpm. Catalog No. 315 serves for all speeds from 300 to 15,000 rpm. Instruments are claimed to have an accuracy of 1% of full-scale reading, designed for heavy-duty service. Operating mechanism is entirely on ball and oilless bearings and therefore requires no lubrication. *Herman H Sticht Co, 27 Park Pl, New York 7, New York*

Induction Heater

COMPACTLY BUILT ac induction heater brazes, solders, anneals, hardens and preforge-heats in many applications. With a low-loss coupling arrangement, new electronic generator may be adapted to a wide variety of metal-working applications without radio-frequency transformers. Predetermined automatic timing controls each unit operation. Operator pushes start button and when operation is completed, unit automatically shuts off.

Other features include (1) current-limiting circuit for protecting oscillator filament and prolonging tube life (2) 3-phase rectifier on larger-size units to obtain maximum power and prevent unbalance of power line and (3) safety devices for full protection of operator and unit. All models having a capacity of 10 or more kw operate from either 220 or 440 v, 3-phase supply. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

Cable Connector

COMBINATION 2-WAY CONNECTOR accomodates several sizes of wire. High-clamping pressure is exerted by the plates, held in place by socket-head cap screws. It also serves as a reducing connector within wire limitations of each size fitting. *O Z Electrical Mfg Co, 262 Bond St, Brooklyn, N. Y.*

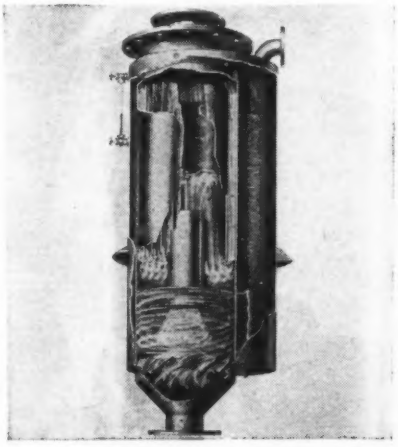
Welding Electrode

FLEETWELD 47 SHIELDED-ARC electrode for general-purpose welding of mild steel is claimed to offer such advantages as low spatter loss, easy slag removal, excellent restriking characteristics and other improved features. It conforms to American Welding Society electrode specifications Class E-6012 and E-6013 and may be used with either ac or dc. Electrode is especially well suited for making high-speed horizontal or flat fillet welds over 4 in. long in which coating can be dragged on both plates. It is also for both vertical and overhead fillets, especially where large single-pass fillets are desired.

Electrode is available in following sizes: $\frac{5}{32}$x14, $\frac{3}{16}$x14, $\frac{1}{4}$x18 and $\frac{5}{16}$x18. *Lincoln Electric Co, Cleveland, Ohio*

Heat-Recovery Silencer

DESIGNED FOR BOTH MARINE and stationary installations, new *Vortex* heat recovery silencer combines four functions in one construction: (1) steam generation up to



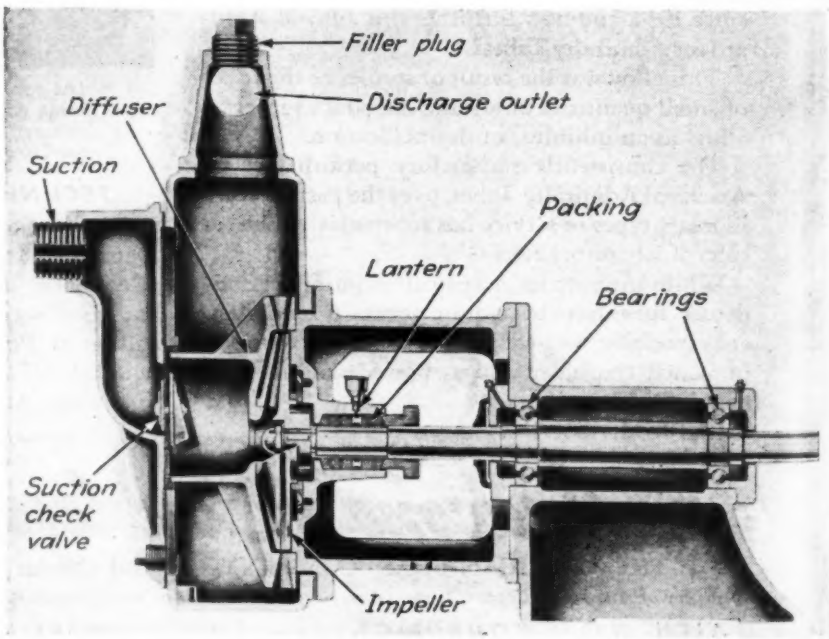
30 psi, depending upon the service (2) hot-water heating (3) exhaust silencing and (4) removal of sparks and carbon from exhaust gases. Yet, according to maker, it normally occupies little more space than would be required without steam or hot-water features. *Engineering Specialties Co, 39 Cortlandt St, New York 7, N. Y.*

Diffuser Pump

A HIGHLY EFFICIENT diffuser pump (shown below) has been perfected wherein impeller with diffuser ring has been submerged inside a casing sufficiently large to hold a liquid reservoir which will assure self-priming under all conditions.

During priming or repriming cycle, reservoir liquid circulates or drops back through diffuser passages to tips of revolving impeller. Entire periphery of impeller

(*Continued on page* 146)

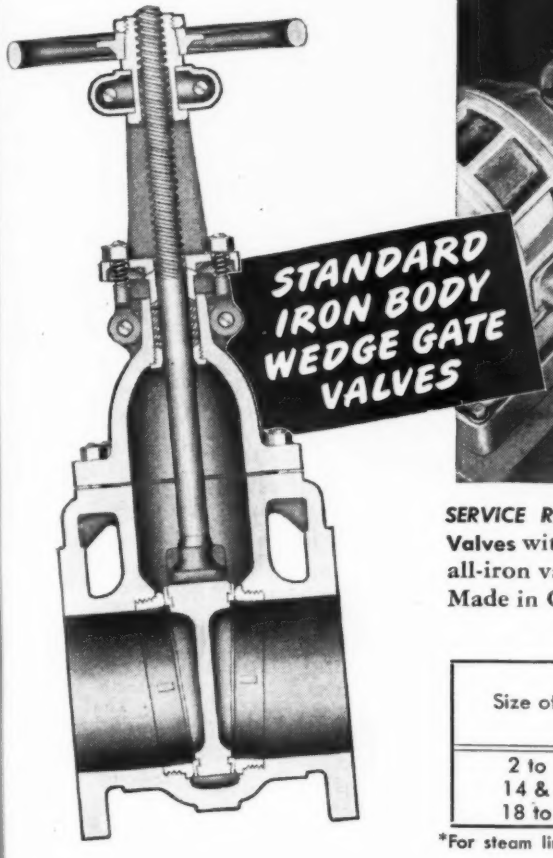


DEPEND ON CRANE . . . WHEN IT'S PIPING EQUIPMENT YOU NEED

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY FOR ALL PARTS • ONE STANDARD OF QUALITY

To keep piping at its best, to simplify and speed up deferred replacements—call on the Crane line. You choose from the world's greatest selection of piping materials—in brass, iron and steel. One source—your Crane Branch or Wholesaler—supplies on one order all your requirements. Every part is uniform in quality, backed by a single responsibility. Your whole task from ordering of parts to installing them is simplified—and at the same time you are benefiting by Crane Co.'s 90-year leadership in the field of piping materials. Below is an example of Crane complete lines—in Standard Iron Body Wedge Gate Valves.

Boiler control system for regulating dampers



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** with Brass trim are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S.&Y. and Non-rising Stem patterns.

Working Pressures

Size of Valve	Screwed or flanged end valves		Hub end valves
	Saturated Steam	Cold water, oil or gas, non-shock	Cold water or gas, non-shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 & 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150 pound Cast Steel Gate Valves are recommended. (For sizes under 2 in., use Crane Clamp Gate Valves.)

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

90 YEARS OF PROGRESS 1855 1945

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Good Old Days? ? ?

Historians paint a pleasant, leisurely picture of the "good old days," when a man's interests were limited by the radius of his or his horse's feet. Nowadays, "leisure" is only our travel time between activities. But, recently, *The New York Sun* carried a story of price regulations in York County, Pa., as early as 1752. Here are typical items:

	Shillings	*Pence*
One man's breakfast	0	6
One man's dinner	0	8
One man's supper	0	6
One pint good Madeira wine	1	3
One gill good West Indian rum	0	4
One gill good whisky	0	2
One quart good beer	0	4
One horse at hay one night	0	8
Half a gallon of good oats	0	3

Considering that the British shilling is worth about 20 cents and the penny about two cents, there still seems to be some truth in the frequent remarks about those "good old days."

But the next item in the same newspaper gives the other half of the story. It informs us that Grinling Gibbons, most famous of English woodcarvers, died in 1721, after seven years as master carver in wood to George I—at a salary of one shilling and sixpence a day! In other words, if he stopped at an inn, he could have his choice of three meals, with sixpence for a bed, or a pint of wine. Good old days indeed!

Just so you won't consider that unusual, let's compare more modern conditions: In 1879, America had a little less than 3½ million hp in its factories, 2¾ million workers, and paid out $950 million in annual wages. In 1929, we had almost 43 million hp, 8.8 million workers, and $11.6 *billion* in wages. So while horsepower and wages increased over twelve times, workers increased 3¼ times. By my arithmetic, workers were making about four times as much as they had 50 years earlier.

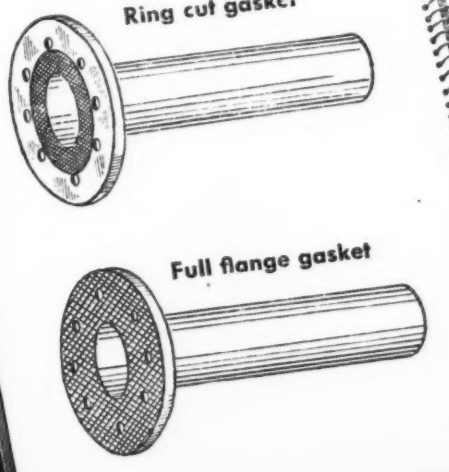
We can't compare buying power exactly, but in 1899 the average man worked 56.8 hr a week, in 1939 he worked only 37.6 hr—a decrease of 34%. But a year's supply of clothing, which cost 708.5 hr of work in 1914, cost only 304.6 hr in 1938, and the car that cost 4514 hr dropped to 1098 hr—and was a better automobile.

I may be wrong, but I think the "good old days" are largely just embroidered memories. Sure, I remember that dill pickles and cheese and bread all tasted better then than they do now, but we didn't have ice cream, and a quarter was all the spending money I got out of my week's pay. I won't even argue about the automobile, radio, movies and airplanes, all of which are hardly unmixed blessings.

But my real point is this: Our power development is the principal element in our advances these past fifty years. The U. S. has more than three times the horsepower of any other nation. That—the product you produce—is the major factor in helping us win this war, in letting us all live as kings never could, and in giving us time in which to dream about "the good old days."

George Edwards
Engineer

How to Seal Pipe Flanges...



A *ring cut* gasket, properly applied, does a better job than a *full flange* gasket. Here are a few hints that will help:

1. Make sure flanges are perfectly clean and true.

2. Use as thin a gasket as possible for the particular flange condition. (The rougher the flange surfaces, the thicker the gasket needed.)

3. See that the gasket is properly centered and does not project inside the flanges.

4. Pull up the flanges evenly and tightly, alternating from side to side to insure even pressure all around.

...and here's the Packing to do the job.

• You won't have to worry about pipe flanges if you seal them with J-M Service Sheet!

This has been proved by thousands of users over many years. That's why Service Sheet is today recognized as the No. 1 sheet packing for high pressure and high temperature conditions against super-heated steam, air, gas, water, hot oil, ammonia, acids, chemicals and many other fluids and gases.

To meet the increasingly severe demands of industry, Service Sheet has been constantly improved. Its dependability and high degree of uniformity are the result of quality ingredients and special manufacturing techniques developed during 75 years of experience in the production of packings.

For further information about Service Sheet and other J-M Packings to meet specialized conditions, write Johns-Manville, 22 East 40th Street, New York 16, New York.

Johns-Manville

PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

FOREIGN FIELDS • MODERNIZATION • FUEL CONSERVATION

Frank Berry Allen, Noted Engineer, Dies

Frank Berry Allen, president of Allen-Sherman-Hoff Co and exponent of modern methods of ash handling, died April 8 of a heart attack. He was 58. Mr. Allen, who lived at Flat Rock Rd, Narberth, Pa., was the son of the late Edgar F Allen, founder of the International Society and the American Society for Crippled Children.

The younger Mr Allen was a member of the Union League, Merion Golf Club, Engineers Club and served as president of the Metropolitan Philadelphia Society for Crippled Children. A graduate of Case School of Applied Science, 1908, he was well known in the power field for his many engineering contributions.

He is survived by his wife, Eleanor M Allen; a son, Flight Officer Homer E Allen, USNR; and a daughter, Cadet Nurse Mary Blythe Allen.

V-E Day May Affect Brownout Enforcement

James F Byrnes, retiring as War Mobilization Director, indicated that the brownout would be lifted within a short time after V-E Day. There was no implication as to whether his successor, Fred Vinson, would adopt the Byrnes program and junk the brownout and other restrictive measures, or whether he would retain all coal-saving measures until the need for saving coal ends.

The plan to drop the brownout immediately on German capitulation came as a surprise to Office of War Utilities and to the Solid Fuels Administration for War. An SFAW spokesman declared that WPB's most recent figures on industrial activity after V-E Day indicated a demand for 590,000,000 tons of bituminous coal in the twelve months succeeding V-E Day and that the anticipated production in the coal year beginning April, 1945, is only 575,000,000 tons. Thus there was considerable confusion in Washington as to why the brownout, which promises to save more than 2,000,000 tons of coal yearly, is to be discarded after V-E Day.

(*Continued on page* 174)

YOU CAN HELP

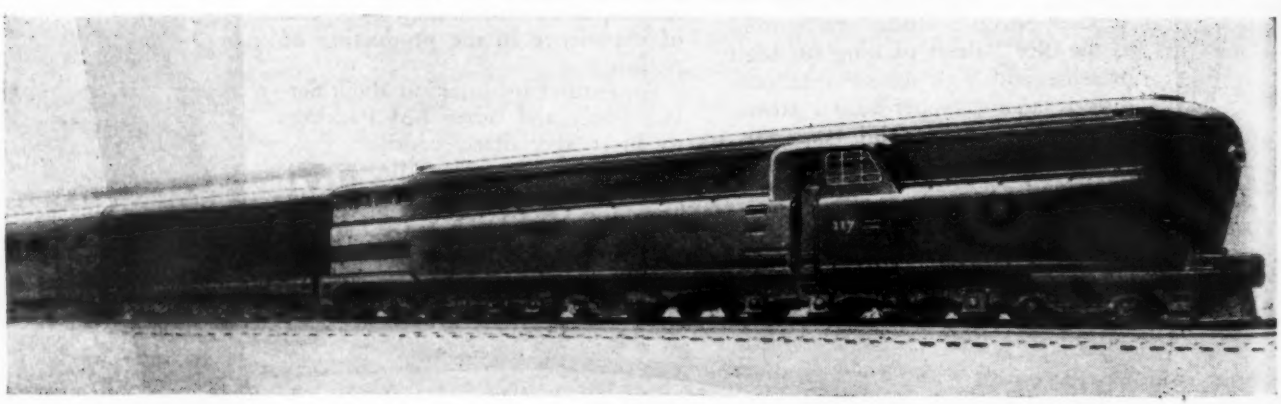
Paper is a No. 1 war-material shortage because over 700,000 different war items are wrapped, packaged, labelled, tagged or made from paper or container board. The Pacific war, when it speeds up, will require stupendous amounts of paper and board since double and triple packing are required for protection against weather, insects, etc.

So please —

1. Share this magazine with your associates. Because of the paper shortage, the number of copies is limited.

2. Organize for a continuous drive in your office and plant to collect waste paper of any kind to put into paper salvage. Clean out old files, dead correspondence, obsolete records, useless display materials, cartons, etc.

AND NOW A TURBINE-ELECTRIC LOCOMOTIVE



Newest entrant for postwar railroad honors is this streamlined turbine-electric locomotive of revolutionary design, one of three to be built by Baldwin for Chesapeake and Ohio Railway as soon as WPB grants permission. It will mark a return to turbine-electric drive, no unit of this type seeing service on any railroad in this country today. Rated at 6000 hp, unit will be capable of 100 mph under full load. Coal supply will be carried at head end and cab will be located well forward to give full vision. Boiler will take up center section behind cab. At rear, steam turbine and generators, to be designed and built by Westinghouse, will feed 4000 kw to motors mounted on each drive wheel

O.K. Joe—

NOW YOU CAN KEEP AHEAD OF ALGAE GROWTH

Joe, a Superintendent at an ice and refrigeration plant says—"Algae forming on the condenser tubes on the roof gives us a lot of trouble. We scrape the tube regularly but we cannot keep up with the growth."

Source: Survey conducted by a well-known power publication.

... says N. A. Schmitt

Nalco Representative
St. Louis, Mo.

Photo in Nalco Laboratories

SURE, algae grows thick and fast but scraping the condenser tubes, Joe, will give you only temporary relief. What you want is a *permanent* remedy.

The Nalco system of water treatment is the answer. Why? Because Nalco engineers and chemists, with the world's finest and most modern water treatment laboratories at their disposal, approach the subject of water treatment as an exact science. Nalco treatment goes right to the heart of the trouble and either *prevents it* or *eliminates it* once and for all!

Whatever your water treating problem is, Joe, call a Nalco representative—you will be glad you did.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

Nalco

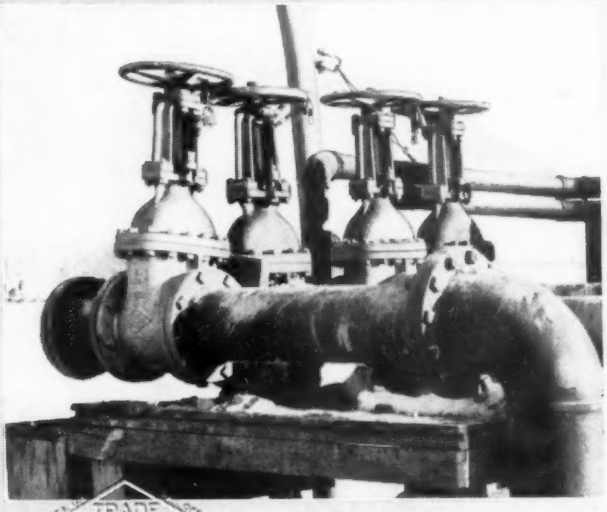
—System of Scientific Water Treating Service . . . for all industry

America's

Jenkins has earned repeated Army-Navy "E" and Maritime Flag Awards by increasing production tremendously to meet endless war needs . . . but no slightest sacrifice has ever been made of Jenkins standards in materials, design, or workmanship.

TRADE JENKINS MARK
Jenkins Bros

Jenkins Valves installed on the pipe-lines of a storage tank at an advanced base in the South Pacific.

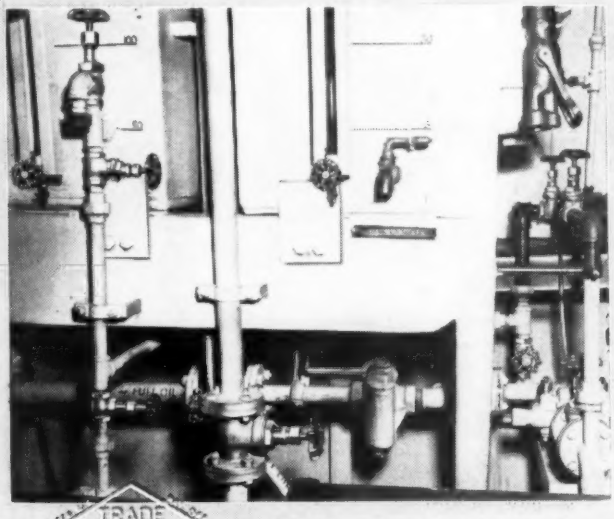


TRADE JENKINS MARK
Jenkins Bros

At oil terminal docks throughout the world Jenkins Valves control the flow of "fighting fluid".

TRADE JENKINS MARK
Jenkins Bros

Jenkins Valves in the engine room of an LCI must be equal to the toughest shock tests of embattled landings.



TRADE JENKINS MARK
Jenkins Bros

Like these on the "piping life lines" of a cargo carrier, Jenkins Valves are serving continuously on ships of every class.

JENKINS VALVES

SINCE 1864

Fighting Men find "DIAMONDS"

along the vital "fluid highways" of their mammoth war machine...

American land, sea, and air forces find the famous Jenkins Diamond trade mark wherever they serve, afloat or ashore, on hundreds of thousands of Jenkins Valves that control the "fluid highways" so essential to the steady march toward victory.

To these men, faced with stupendous tasks of moving rivers of "fighting fluids," and with operating equipment under the worst conditions imaginable, the Jenkins Diamond means dependable valve performance – a quality far more precious to them than bushels of real diamonds.

Wherever the American flag flies throughout the world, new millions of men are learning what valve-wise piping specialists have known for more than 80 years . . . that the Jenkins Diamond is the mark of *trustworthy* valves.

It will remain our pledge of superlative quality, as long as Jenkins Valves are made.

• • •

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta, Boston, Philadelphia, Chicago, San Francisco. Jenkins Bros., Ltd., Montreal, London.

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JENKINS
MARK
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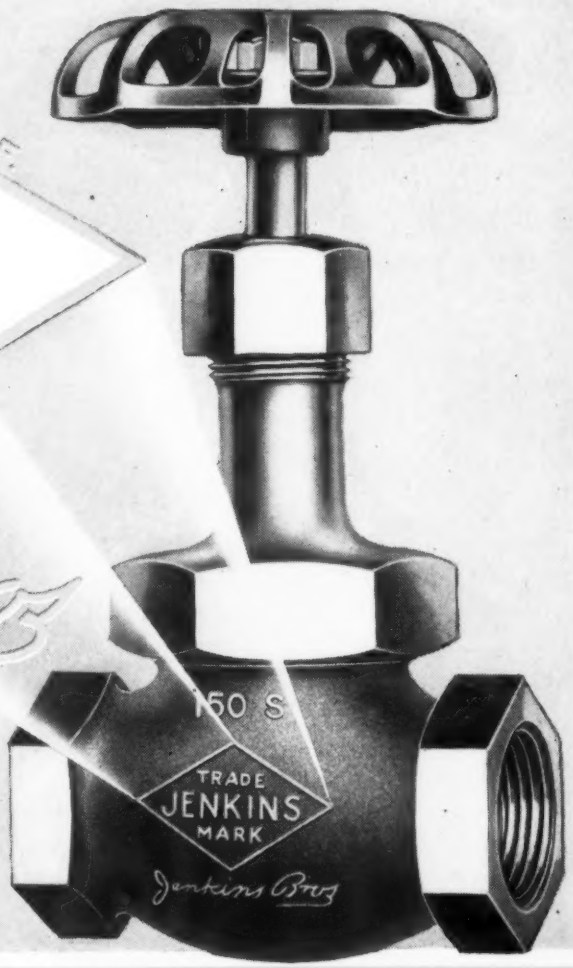

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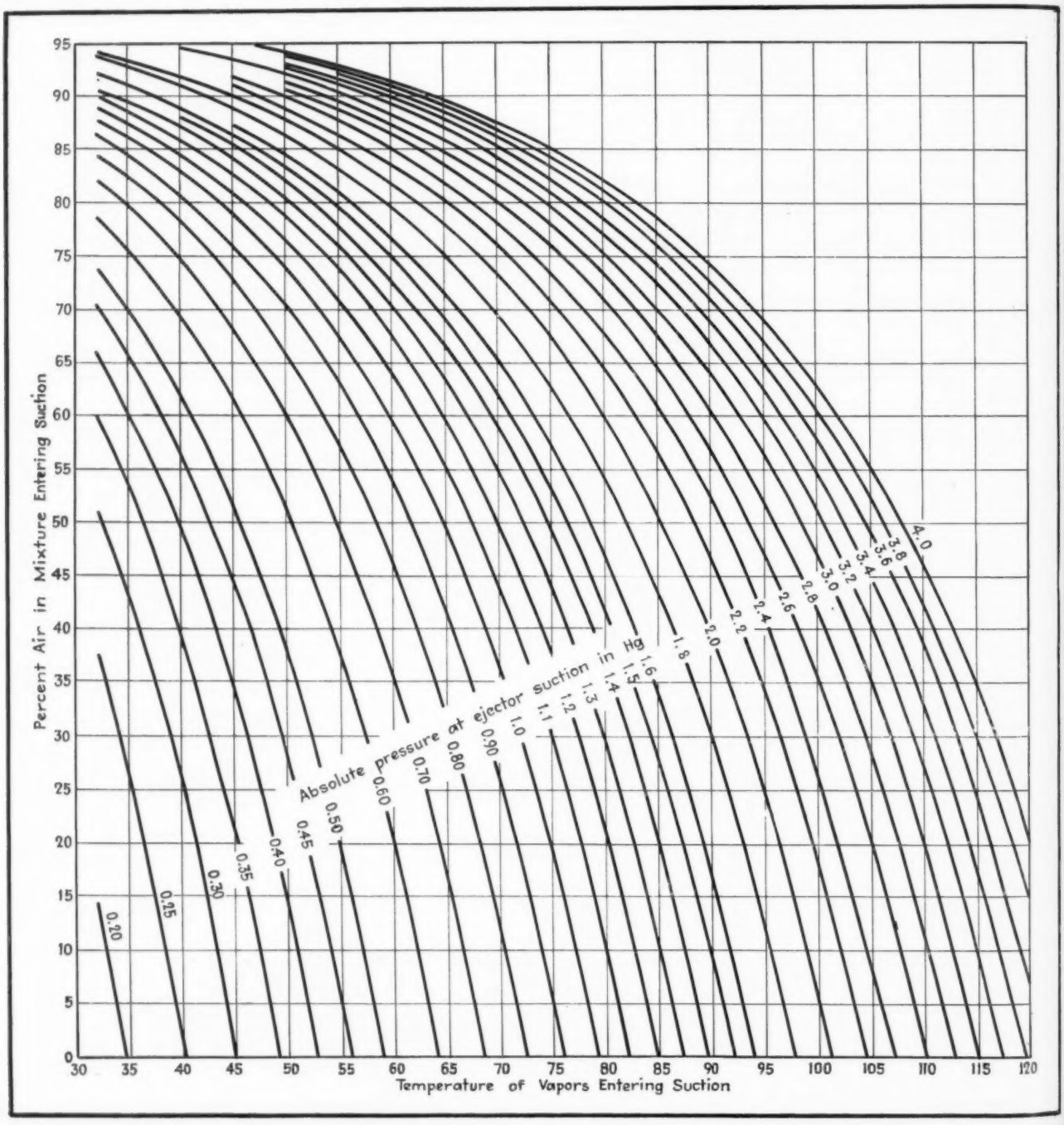
POWER'S
DATA SHEETS

Number 153

Steam-Ejector Check Chart

This plot of Dalton's law especially prepared for condenser and ejector analysis shows vividly the great increase in ejector load for slight decrease in subcooling. To use the chart, first read vacuum at ejector suction and subtract from barometer. Read temperature at same point with thermometer carefully shielded against conduction and radiation error. Chart gives percent air in mixture leaving condenser. Decrease in percent air at identical load and circulating-water conditions indicates fouled condenser tubes.

Philip Freneau, Worthington



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1908

Introduction of thermal expansion type regulator invented by James W. Copes. The first real step toward effective feed water control.

1913

Copes Engineers announce new and revolutionary method of feed water control—"continuous feed varying with load, and level varying inversely with load."

1916

Initial research on flow through control valves, leading to design for individual boiler conditions.
First 6-inch regulator ever made installed at Delray Station, Detroit Edison Company.

1917

Research into the influence of excess pressure variations on feed regulation, resulting in development of first differential pressure devices.

1918

Development of rotary stem control valves to reduce stem friction to low and constant amount, as against high variable friction of sliding stem.

1919

Manufacture of Copes Regulators begun in foreign countries. Within a few years Copes became the accepted standard in Europe, Asia, South Africa.

1920

Copes Regulators installed on 1100 psi. European-built boilers when 450 psi. was highest pressure in the United States.

1921

Originated tight seating valve fittings having equal upper and lower seat areas. Patent granted.

Leaders and Specialists for 36 Years in

BOILER FEED WATER CONTROL

NORTHERN EQUIPMENT CO . *1241 Grove Drive, Erie, Pa.*

Feed Water Regulators • Pump Governors • Differential Valves • Liquid Level Controls • Reducing Valves & Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND — REPRESENTATIVES EVERYWHERE

1924

Copes Regulators designed with expansion tubes in TENSION set new record in simplicity and reliability. Patent granted.

1926

First successful multiple element feed water control—Copes—installed at Ford Motor Company.

1927

Copes installed on first 1400 psi. boilers in the United States—Boston Edison Company.

1928

Basic patents secured on combination of feed water regulator and differential pressure valve.

1930

First 8-inch feed water regulator—a Copes—installed at New York Steam Company.

1932

After careful tests and investigations, all radio controlled ships of U. S. Navy equipped with Copes Regulators.

1934

Six years' research completed with development of first valves really balanced under operating conditions.
Patents granted on 2 types of 3-element regulators.

1937

Patents granted on remote control of feed water regulator and other control valves.

1938

Produced the Copes Flowmatic, a 2-element regulator—recognized as one of the greatest advancements in the art of feed water control for modern boilers.

1941

Introduced a Copes Marine Regulator not influenced by roll or pitch of the vessel. Now installed on hundreds of ships.

1942

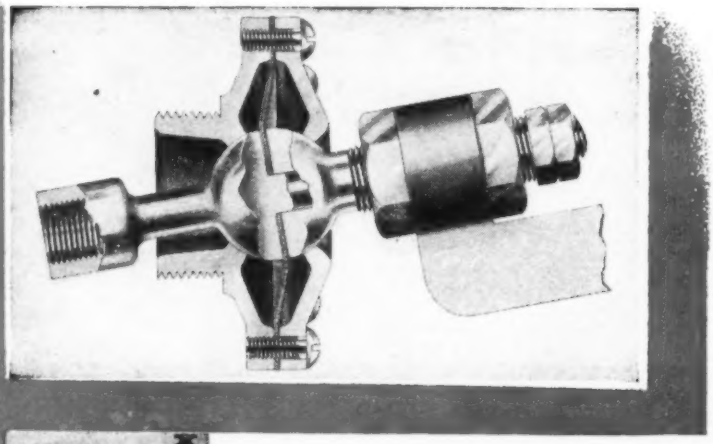
Copes Flowmatics installed on largest forced circulation boiler in the world—650,000 lbs. per hour at 1825 psi.—Montaup Electric Company.

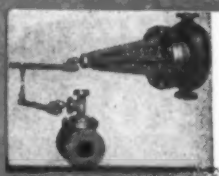
194X

Peacetime application of developments and improvements fostered by intensive war production activities.

Only Davis

LIQUID LEVEL CONTROLS





Davis 161D Float Box and 468 Control Valve, each equipped with Dia-Ball packless transmission unit. An ideal control. Installed outside tank.

No. 162D Packless Float Box with Pilot Valve and No. 14 Diaphragm Motor Valve.

Davis No. 170 Fluid Level Controller with Control Valve, for horizontal tanks.

Davis No. 160D Float and Lever Tank Unit flange mounted with Dia-Ball Transmission Unit. For use in vertical tanks.

. . . have the packless Dia-Ball Transmissions

Where engineers want leakproof liquid level controls and freedom from the maintenance required by packing boxes, Davis offers Float Boxes, Control Valves and Float and Lever Units equipped with the patented Davis Dia-Ball packless transmission unit.

Features of the Dia-Ball Unit include: no packing; leakproof construction; dependable, trouble-free design; minimum friction; Straightlined Power—no breaks or offsets; and corrosion-resistant assembly. This unit is especially recommended where volatile or inflammable fluids are being used, because of its leakproof construction.

The Davis line also includes Float Boxes, Control Valves, and Float and Lever Units with conventional packing box transmission, as well as Motor Operated and Pilot Valves.

For complete information, ask for Bulletin 101 AA.

Davis Regulator Company
2540 So. Washtenaw Ave.
Chicago 8, Ill.

DAVIS VALVES

DAVIS REGULATOR COMPANY

Reader's Problems

(*Continued from page* 113)

entering the boiler, and circulation would be at its lowest, I do not believe that steam bubbles containing latent heat of evaporation would be released. Additional heat loss from this source could be disregarded from a practical point of view.

Determine the quantity of water flashing into steam, and the temperature, as follows: Since the water at atmospheric pressure cannot be above the boiling point (212 F at sea level) take that as its temperature after flashing.

Assume a boiler pressure of 99.3 psig, or 114 abs; from the steam tables we get a total heat above 32 F of 308.3 Btu. In the water which remains, total heat content above 32 F is 180 Btu. The difference is 128.3 Btu, the number of heat units that must be dissipated from each pound of blowdown water at this pressure.

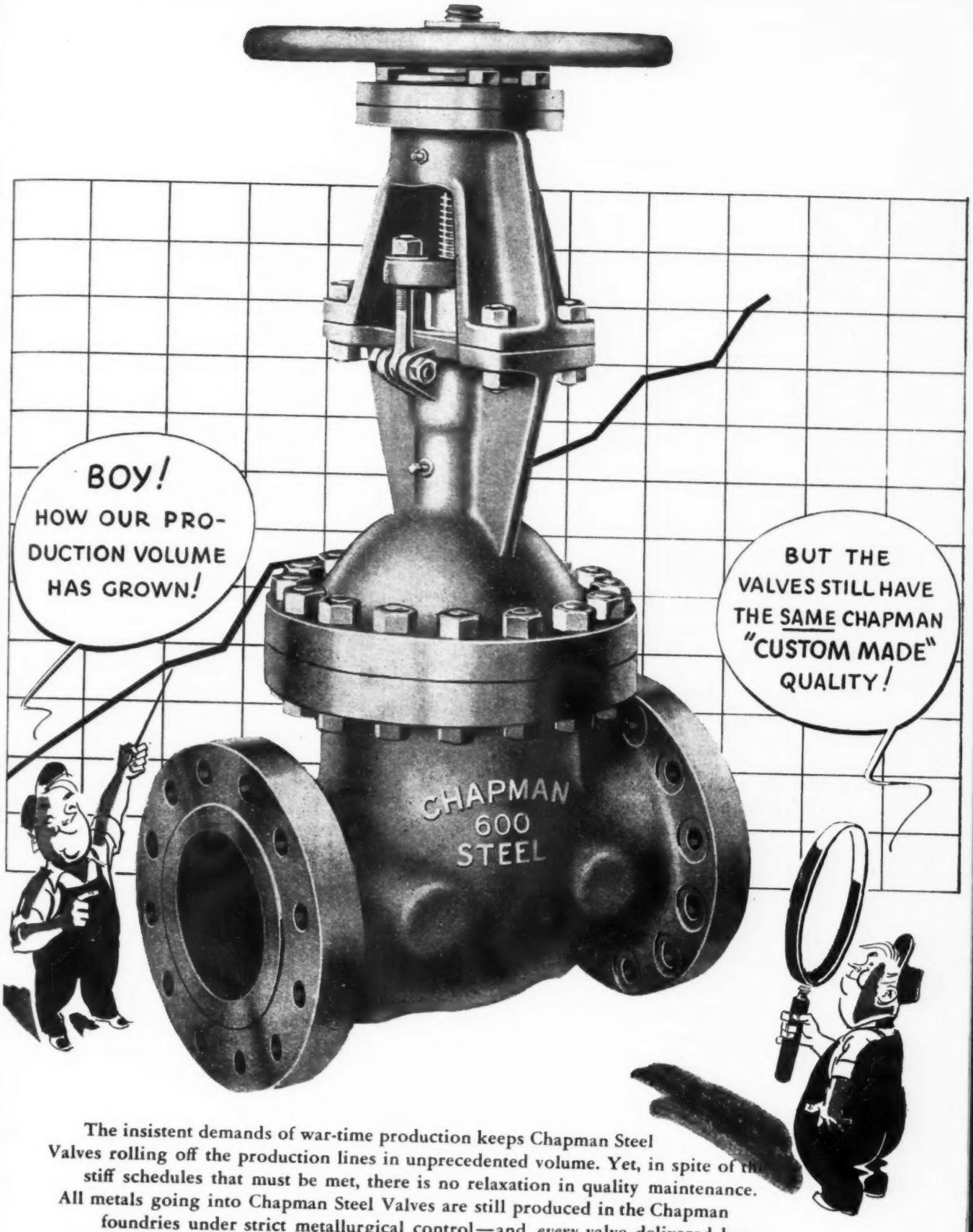
Assuming a blowdown of 1000 lb, which is not uncommon, the total heat lost would be 1000x128.3, or 128,300 Btu. Since this heat must be dissipated it converts a portion of the water into steam. Therefore, since the heat of evaporation at 212 F is 970.4 Btu, the quantity of water flashed is: 128,300 ÷ 970.4 = 132.2 lb, or 13.2%.

Hanover, N. H. A L WATERMAN

Loss Depends on Feedwater Temperature

ACTUAL LOSS in Btu per pound of effluent discharged as blowdown depends upon the boiler pressure and feedwater temperature. For example, saturated steam at 25 psi abs (10 psi gage) has a temperature of 240.07 F and the liquid contains 208.42 Btu per lb, while saturated steam contains 1160.6 Btu per lb, of which 952.1 Btu is the latent heat of evaporation. Saturated steam at 160 psi abs has a temperature of 363.53 F and the liquid contains 335.93 Btu per lb. while the vapor has a heat content of 1195.1 Btu, of which 859.2 is latent heat.

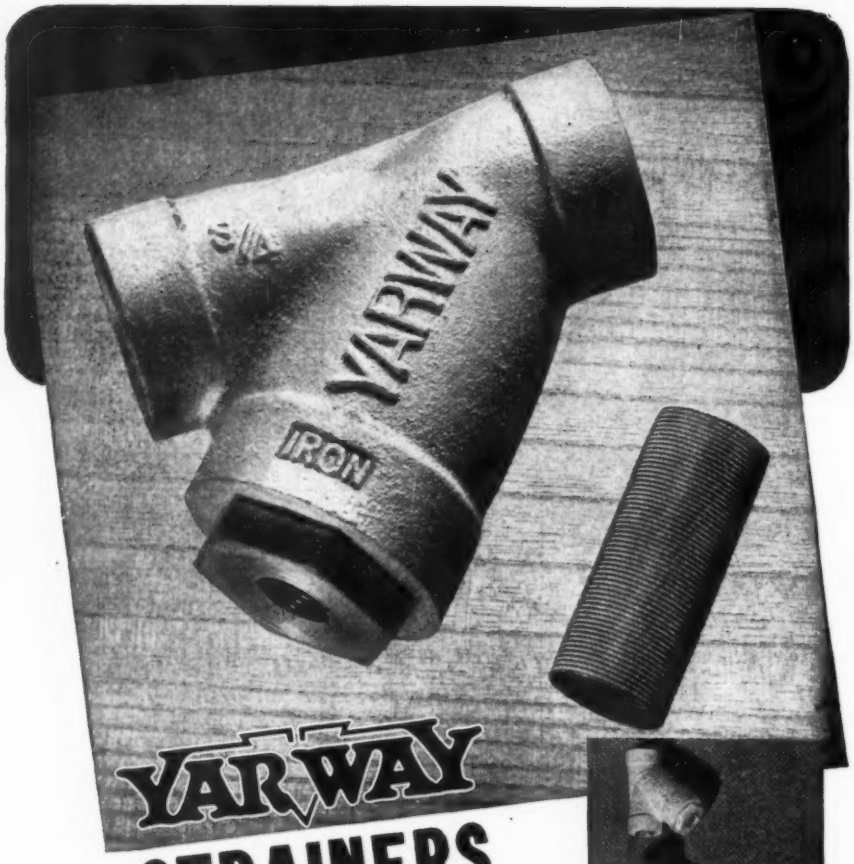
The previously mentioned heat content is based on 32 F so the difference between the temperature of the feedwater as received (before going through the heater) and the freezing point of 32 F must be subtracted from the boiler water's heat content. For instance, if feedwater temperature is 70 F and boiler pressure is 160 psi abs, loss per pound of blowdown would be about 335.93 —



The insistent demands of war-time production keeps Chapman Steel Valves rolling off the production lines in unprecedented volume. Yet, in spite of the stiff schedules that must be met, there is no relaxation in quality maintenance. All metals going into Chapman Steel Valves are still produced in the Chapman foundries under strict metallurgical control—and *every* valve delivered has a precision rating equal to that of a custom-made unit—meeting *or exceeding* standard specifications.

So check with Chapman whenever a valve problem arises.

The CHAPMAN VALVE MFG. CO., *Indian Orchard, Mass.*



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"Police the Pipelines"

YARWAY STRAINERS are *selling by the thousands* because they are better engineered for the service.

"*The Screen is the Thing*"—a high-grade, woven Monel wire screen that stops the dirt, lets fluids flow freely.

Then, too, purchasers like the *body finish—Cadmium plating inside and out* for protection against corrosion.

And last but not least, it is "*Easy to Clean*" having a steel blow-off bushing, precision machined with straight thread. Screen and bushing come out together—go back together, automatically aligning.

Six sizes, ½" to 2" for pressures up to 600 lb serve practically all strainer needs.

Sold by over 100 Mill Supply Houses. See your Supply House or write for Bulletin S-200.

YARNALL-WARING COMPANY
100 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

(70 — 32) = 297.93 Btu per lb.

Normally the steam entrained in the blowdown is negligible, but the higher the pressure the greater the percentage of water that flashes into steam upon release from the boiler. Any standard handbook containing steam tables gives data for calculating the loss at various pressures.

Oak Ridge, Tenn. I A BUTCHER

Loss In Tons of Coal

IF THE BLOWDOWN is made direct from boiler pressure to the atmosphere, part of the water will flash into steam. However, no high-pressure steam will be lost.

Consider a boiler operating at 150 psi abs. Heat content of the liquid at this pressure is 330.5 Btu per lb and that much heat will be lost in every pound of blowdown water unless it is first passed through a heat exchanger. Discharging directly to the atmosphere, 15.5% of the water flashes into steam, but this does not affect the amount of heat lost.

Blowdown loss can be easily evaluated in terms of fuel. In the example given, suppose the fuel is coal with a heating value of 11,000 Btu per lb. Divide 11,000 by 330.5 and multiply by 2000 to find that, neglecting boiler efficiency, 66,600 lb of blowdown is equivalent to a ton of coal. If boiler efficiency is 70%, 46,600 lb of blowdown equals a ton of coal.

Denver, Colo. K M HOLADAY

Blowdown Is Free Of Steam Bubbles

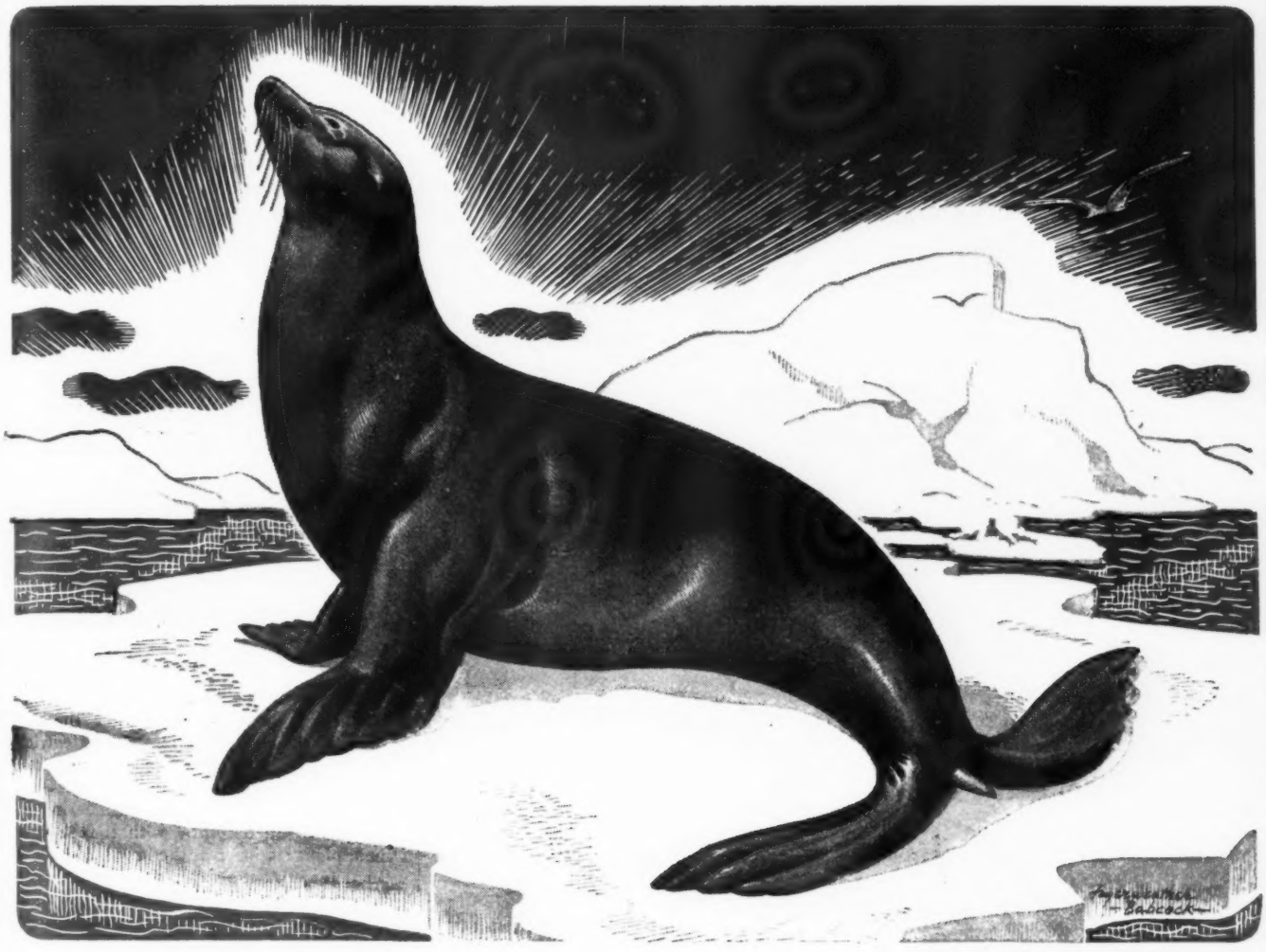
DISCHARGE from a boiler with the blowdown line in the rear of the shell, in the path of the downcoming water, does not contain steam bubbles. Assume the boiler pressure to be 200 psi abs; total heat of liquid is 355.4 Btu.

At the end of the blowdown line the liquid immediately drops to 212 F and the excess, 355.4 — 180 = 175.4 Btu, dissipates by flashing water into steam at 212 F. As it requires 970 Btu to evaporate one lb of water at atmospheric pressure, 175.4 ÷ 970 = 18% (by weight) of liquid that flashes into steam.

Annadale, N. Y. WILFRED HAYNES

Steam Tables Provide the Answer

AMOUNT OF BLOWDOWN WATER that flashes into steam can be determined from Keenan and Keyes' steam tables. Take heat of liquid at boiler pressure, subtract heat of liquid at atmospheric



It's easier to insulate a streamlined job

NATURE found it comparatively simple to insulate a streamlined job like the seal, but did you ever try to wrap up a giraffe? Men who have to insulate flanged or threaded fittings in a piping system will readily understand the comparison. By the same token, Tube-Turn welding fittings give a streamlined silhouette which is easily insulated, with never a leak to cause insulation replacement.

Other Tube Turns advantages directly related to cost include lighter weight, greater strength, longer life, and the consequent lower maintenance. Smooth turns free from obstructions make for increased efficiency of flow. And Tube-Turn welding fittings permit installation of a piping system in less space, with greater flexibility of layout.

For complete information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

Selected Tube Turns Distributors in every principal city are ready to serve you from complete stocks.

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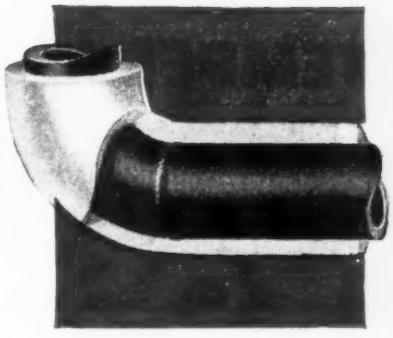
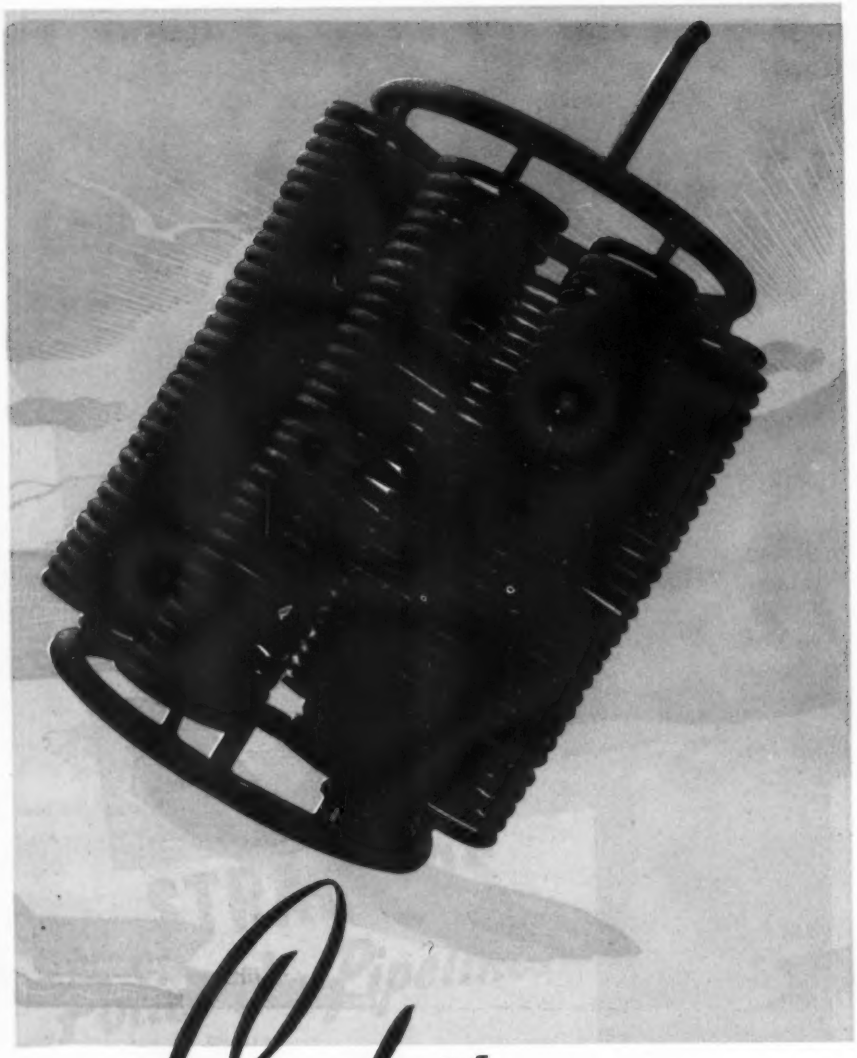


Smooth, permanent insulation

Because Tube-Turn welding fittings make smooth, leak-proof turns, insulation goes on easily, never needs to be removed because of leaks.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*



Conduit FOR TEMPERATURE EXTREMES

Above is a unit of industrial fabrication essential for the processing of fats and edible oils. This bed spring type coil, consisting of 1300 ft. of 1-¼" seamless tubing, has high ductility. Since it will be subjected to rapid temperature fluctuations (conduit for extremes of live steam and water) it required the character of work that is standard procedure at Associated... Let Associated service serve you!

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or discharge pressure, and divide by the latent heat of steam at atmospheric or discharge pressure. Example:

Boiling point at 100 psig.....338 F
Boiling point in atmosphere.....212 F

Difference .....126 F
Heat content at 338 F.....309.04 Btu
Heat content at 212 F.....180.00 Btu

Difference .....129.04 Btu
Latent heat of steam.....970.04 Btu

The amount of steam generated by lowering the water pressure from 100 psig to atmospheric pressure will be: 129.04 ÷ 970.4 = 0.132 lb of steam per lb of water; or 13.2% of the water flashes into steam.

Brighton, Mass. F J DUNLEA

New Lighting Methods to Lower Production Costs

New industrial lighting, born of wartime production demands, will lower the cost of peacetime goods, John L Kilpatrick, Westinghouse lighting specialist, predicted in a paper at the 37th annual technical conference of the Illuminating Engineering Society. Presented jointly with L N Blugerman, plant engineer at the new Budd Plant, Bustleton, Pa., the paper described successful completion of the first year of lighting of the Budd Plant's great arched bays, which Mr Kilpatrick characterized as "tunnels of shadowless light totaling nearly three miles in length." They are illuminated by a new system of high-intensity indirect mercury vapor lighting.

The paper pointed out that the result of the new system is 35-ft-candles of soft illumination throughout the factory's working area. Mr. Kilpatrick said that all necessity for eye strain from extension lamp glare is eliminated. He predicted that the new system, applied to postwar factories, will revolutionize industrial lighting practices and lead to lower-cost mass production of civilian goods by reducing mistakes, streamlining factory designs and speeding up assembly processes.

Major source of the light itself is the new 3000-watt mercury vapor lamp, used in conjunction with alternate groups of four 750-watt incandescent lamps to obtain a modified color correction. The incandescents complete the color spectrum as incandescent light contains rays from the red end of the color spectrum, which mercury vapor light lacks. This balancing of the spectrum permits workers to identify colors readily.

Before the new 3000-watt lamps were available, glareless and shadowless lighting of such intensity was not practical. No source of light was sufficiently concentrated to provide this level and quality of illumination without using an enormous number of fixtures. The new mercury lamps produce many times more light per watt than other light sources in general industrial use, and therefore take much less space and simplify the wiring system.

Why BRIGGS OIL CLARIFIERS

Can Provide Savings in Your Operating and Maintenance Costs

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Removes
INVISIBLE AS WELL AS VISIBLE CONTAMINANTS

A—FILTERS

Insoluble contaminants . . . dirt, grit, metal chips . . . are removed by ABsorption through outer layer of cellulose on cartridge.

B—PURIFIES

Soluble contaminants . . . gums, acids, resins, that cause corrosion and formation of engine sludge . . . are removed by ADsorption through Molded Fullers Earth . . . the same filtering medium used in the oil refinery process.

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Insoluble contaminants smaller than 1 micron (.00004") are removed by ABsorption through inner layer of cellulose.

Only Briggs Oil Clarifiers . . . with Fullers Earth Type Cartridges . . . give you this 3-TIME, 3-WAY protection.

For effective filtration of additive type oils, the Briggs DISCEL (All Cellulose) Cartridge is recommended.

Only with such filtration as Briggs Fullers Earth Type Cartridges provide, can you expect all the benefits of EFFECTIVE FILTRATION. Because—only by removal of ALL contaminants from lube and fuel oil will you be able to eliminate lacquering, stuck rings, scored bearings, excessive oil consumption, premature wear.

The value of Briggs Fullers Earth Type Refill Cartridges has been proved over the years in thousands of installations—where other methods of filtration have failed. They are installed and are performing excellently on engines that are essential to the prosecution of the War.

For efficient filtration of additive-type oils, Briggs engineers have developed the DISCEL (all-cellulose type) Cartridge, manufactured of specially-processed cellulose in accordance with rigid oil-filtration specifications. Interchangeable with Fullers Earth Type Cartridges on all models.

Complete knowledge of oil filtration problems, plus equipment capable of doing the job have enabled Briggs distributors to help operators of every size and type internal combustion engine. Consult the "Filter" section of your classified telephone directory to find the Briggs distributor in your locality. Or write manufacturer for literature on the complete Briggs line.

G-800

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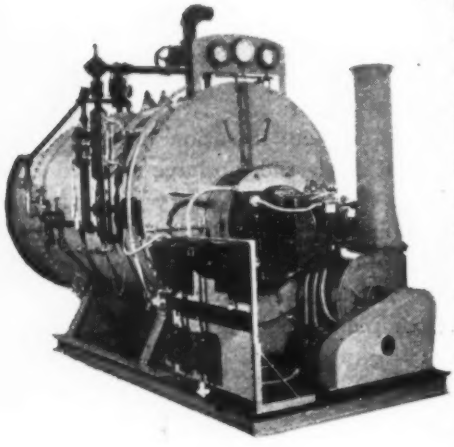
- "With new overall efficiency of 80% or more
- "A complete, compact plant that comes all-in-one—virtually ready to use
- "Oil firing, induced draft, 100% automatic operation
- "A perfect coordinated, utterly dependable, self-contained power-producing unit . . . You'll get it in a

PREFERRED UNIT STEAM GENERATOR

Oil burner, induced draft fan, boiler, controls, all piping, wiring, etc. in one space-saving assembly. No stack required, no special foundation. Starts operating after a few simple connections. 20 to 500 HP sizes available now on priorities.

. . . and a better job, too



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P-5-46

PREFERRED UTILITIES

Synchronous Motors

(*Continued from page 86*)

MF_2, and back to Y. Contactor MF remaining closed holds excitation on the motor, which goes into service.

When relay CR closed it closed contact CR_3 and when MF closed it opened contact MF_2, so that holding circuit for main contactor coil M is from X through the stop button, contacts M_1 and CR_3, coil M, overload-relay contact OL and back to the line at Y. If the motor pulls out of synchronism with excitation applied, it takes high periodic current from the line that causes current element CE to open its contact E.

When contact E opens it breaks the circuit through CR relay coil and this relay drops out to open contact CR_3 and break main contactor coil M circuit. Contactor M opens and stops the motor. When M opens it also opens contacts M_1 M_2 and M_3. Contacts M_2 and M_3 break the circuit through relay coil MF to remove excitation from the motor. Opening of M_1 prevents main-contactor coil M being energized when contact MF_3 closes so that re-synchronizing of motor cannot be started until start button is pressed.

Automatic synchronizing following pull-out can be had by inserting selective jumpers B and C and removing A. Fig. 4. With these connections, holding circuit of MF is through contact E and jumper B. Jumper C short circuit contacts MF_3 and CR_3 so that main-contactor coil M remains energized whether these contacts are closed or open. Thus, when the motor pulls out of step the high current through coils CE opens contact E to break MF contactor-coil circuit and removes field current from the motor. Then it is in condition to be resynchronized as soon as the motor current drops to a value that permits tension spring S to close contact E, point F, Fig. 3.

Woodwaste Piles

(*Continued from page 91*)

pile to a maximum of 44% near the fire zone of the hog-fuel pile. Volatile content, dry basis, never decreased below 75% from about 83% for new fuel. Losses, while not consistent throughout, show clearly the effect of

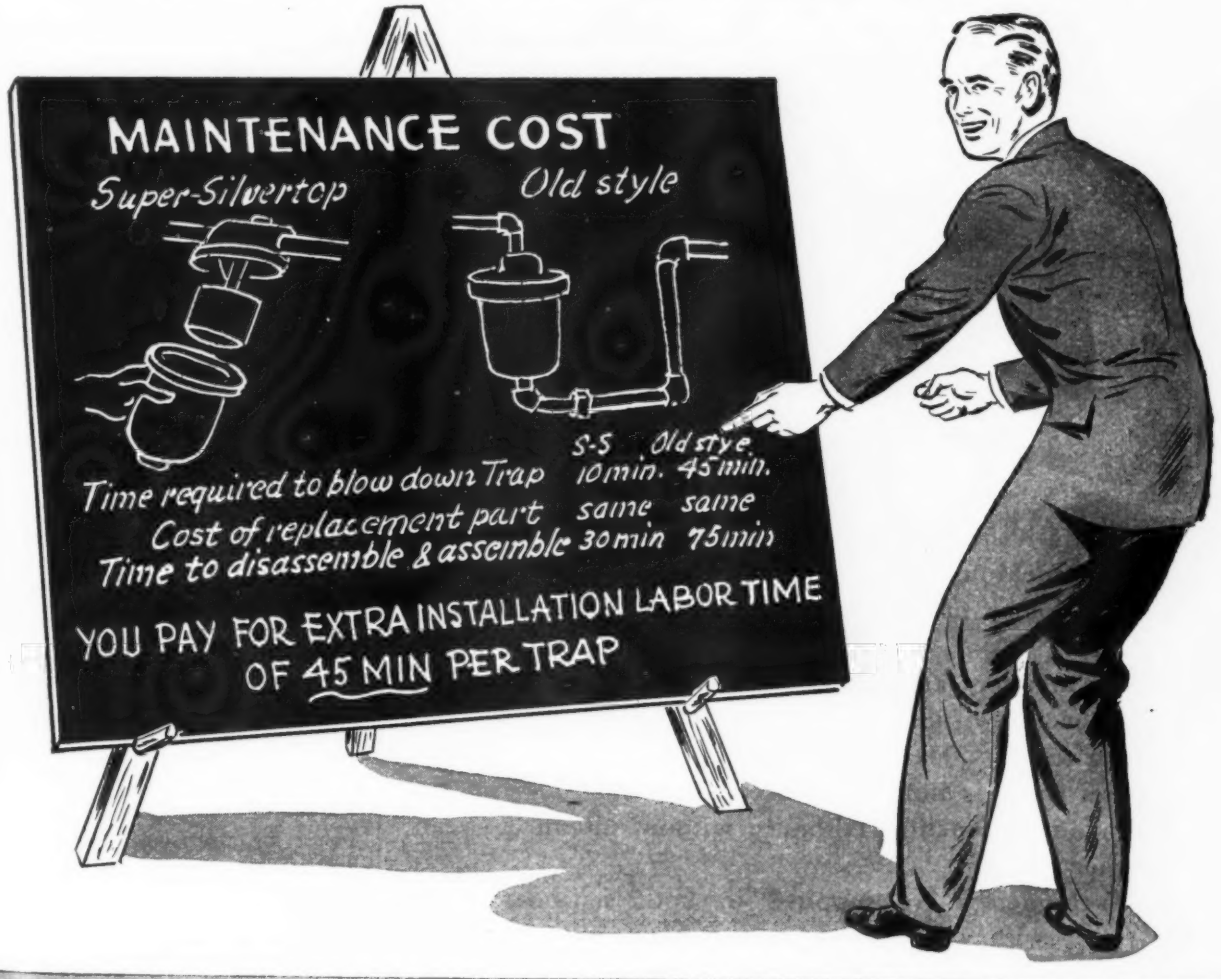
Chalk Talk No. 2

ON POSTWAR STEAM TRAP ECONOMY

It's good engineering practice to inspect steam traps regularly. This inspection can be troublesome and expensive, or easy and economical. The blackboard below shows how easy it is to inspect a Super-Silvertop Steam Trap without removing it from the line, and how difficult it is to inspect the traps with old style piping. Super-Silvertop trap inspection can be made in 45 minutes less time . . . that's 45 minutes less labor to be paid for. Multiply this by the number of traps in use and you can readily appreciate the tremendous saving over the years. Time and wages will be important in the postwar era. That's why you should plan to install only Super-Silvertops with simplified piping. Send for a copy of the book "How To Choose A Steam Trap" . . . . It gives complete details on Super-Silvertop Steam Traps.

Super-Silvertops can be piped as an elbow or straight-in-line.

THE V. D. ANDERSON COMPANY
1934 W. 96th Street • Cleveland 2, Ohio


MAINTENANCE COST
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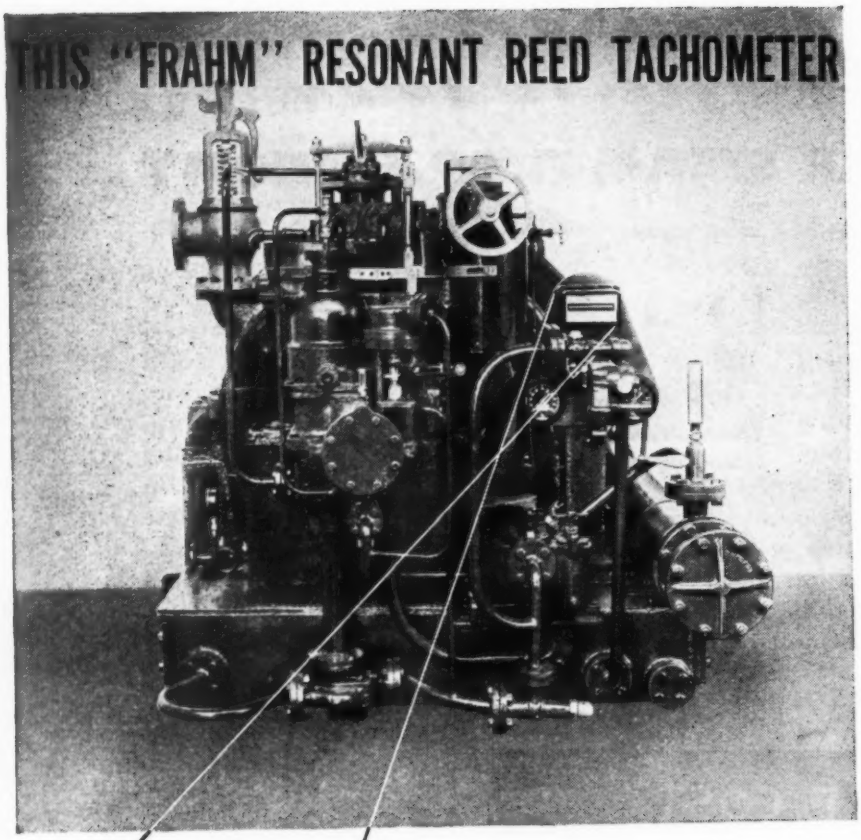
Old style
S-S Old style
Time required to blow down Trap 10 min. 45 min.
Cost of replacement part same same
Time to disassemble & assemble 30 min 75 min
YOU PAY FOR EXTRA INSTALLATION LABOR TIME
OF 45 MIN PER TRAP

Super-Silvertop
STEAM TRAPS

THIS "FRAHM" RESONANT REED TACHOMETER



. . . shows Turbine speed

This is the turbine end of a 300 kw turbine-generator unit built by the Moore Steam Turbine Division of the Worthington Pump and Machinery Corporation. Mounted on the panel board to give a continuous indication of turbine speed is a Frahm Resonant Reed Tachometer.

Frahm Tachometers are chosen for this and many similar applications because of their extreme simplicity of construction and unfailing accuracy. Having no belts, shafts, gears, springs or delicate parts there is nothing to wear out, and they can be depended upon to function faithfully without attention—year after year after year.

Frahm Tachometers are supplied in both stationary and portable types, with various ranges available from 900 up to 60,000 r.p.m.

Write for Bulletins 1590-P and 1740-P. They give a complete description of the instruments and list all types and ranges commonly supplied.

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

storage temperature, being a maximum for the fire zones and also increasing from the bottom to the top (and hotter) portions of the pile.

Comparative value of stored fuel for power production, as determined from tests made by the Water Board, are shown in the table on page 91. Stored fuel, after correction for moisture pickup, will produce within a few percent of the equivalent output of new fuel if skillfully handled. However, stored fuel, because of its reduced volatile content, burns less freely and less load can be carried by a given boiler than with new fuel. The latter is not important at lower ratings but does prevent carrying high peak loads satisfactorily. For comparison with these values, some use an average expectancy of 25% loss in evaporative capacity per volume unit of outdoor-stored fuel as compared to fresh woodwaste.

Chemical Action

Further work on the deterioration of wood fuel in storage is under way by Portland General Electric, largest user of wood fuel in the Portland area. Tests indicate that fires usually, if not always, start as the result of chemical action between woodwaste and metal. It has been proved by trial that fires can be started in this manner. An investigation of chemical treatment of woodwaste to prevent bacterial action during storage is under way. This treatment is similar to one used in pulp mills to prevent mildew in stored ground pulp.

Other investigators confirm the theory of fires starting near metal. These report that black pockets in sawdust piles usually inclose a metal inclusion such as conveyor chain, rivet or piece of wire. Unfortunately, the thermocouple locations in the Eugene test pile did not happen to coincide with the point of origin of fire and therefore cannot definitely confirm the start of fire at the bolt of Fig. 1. Of course fire could have originated at any point of the contact face of the new and old piles, Fig. 2, which was at a temperature of 165 F for many weeks before fire broke out, but visual examination favors fire having started at the bolt.

Moisture Content

In conclusion, it should be noted that fuel stored in the open should be piled deep enough so that rainfall distributed through the entire pile results in a comparatively small percent increase in moisture content. The larger the area covered by a given quantity of fuel, the greater the percent increase in moisture from rain.

UNPRECEDENTED FUEL AND HEAT EFFICIENCY *with this new* LIGHT DENSITY TYPE

PLANT
PRECISION MOLDED
85% MAGNESIA
"THE DEPENDABLE STANDARD—MODERNIZED"
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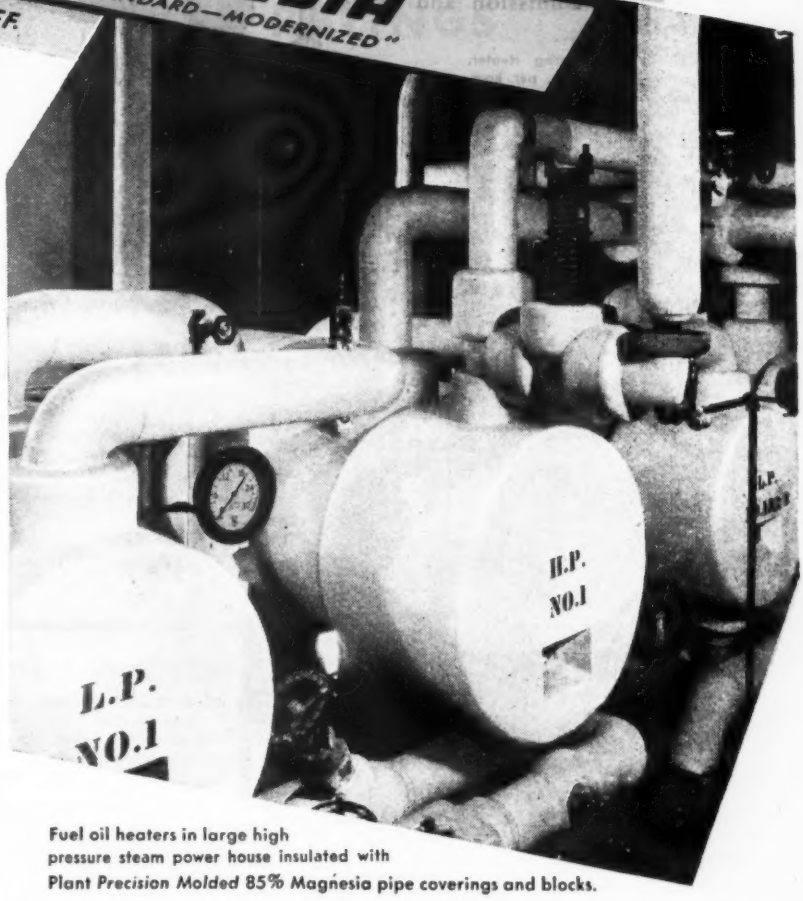
- Weighs just 11 pounds per cubic foot.
- Sets a remarkable new low in Thermal Conductivity over the full range of temperatures.
- Goes on faster and easier—reduces application costs.
- Greater "ductile strength" built right into the product, so that it will withstand shock and vibration.
- Controlled "uniformity". Molded to exact final size and thickness by the special, patented* Plant process. All its surfaces are smooth.

These are just a few of the great heat insulation advancements achieved in this new light density type PRECISION MOLDED 85% Magnesia. Every applicator, engineer and user of heat insulating material will want to have the complete story. Specify for your post-war projects. Write today for data.



Fuel oil heaters in large high pressure steam power house insulated with Plant *Precision Molded* 85% Magnesia pipe coverings and blocks.

*U. S. Patents Nos. 2,131,374, 2,209,752, 2,209,753, 2,209,754.

PLANT RUBBER & ASBESTOS WORKS

MAIN OFFICE: SAN FRANCISCO

SALES OFFICES in Los Angeles, Wilmington and Oakland, California and Houston, Texas; distributors in principal cities.
FACTORIES in Emeryville, San Francisco and Redwood City, California.

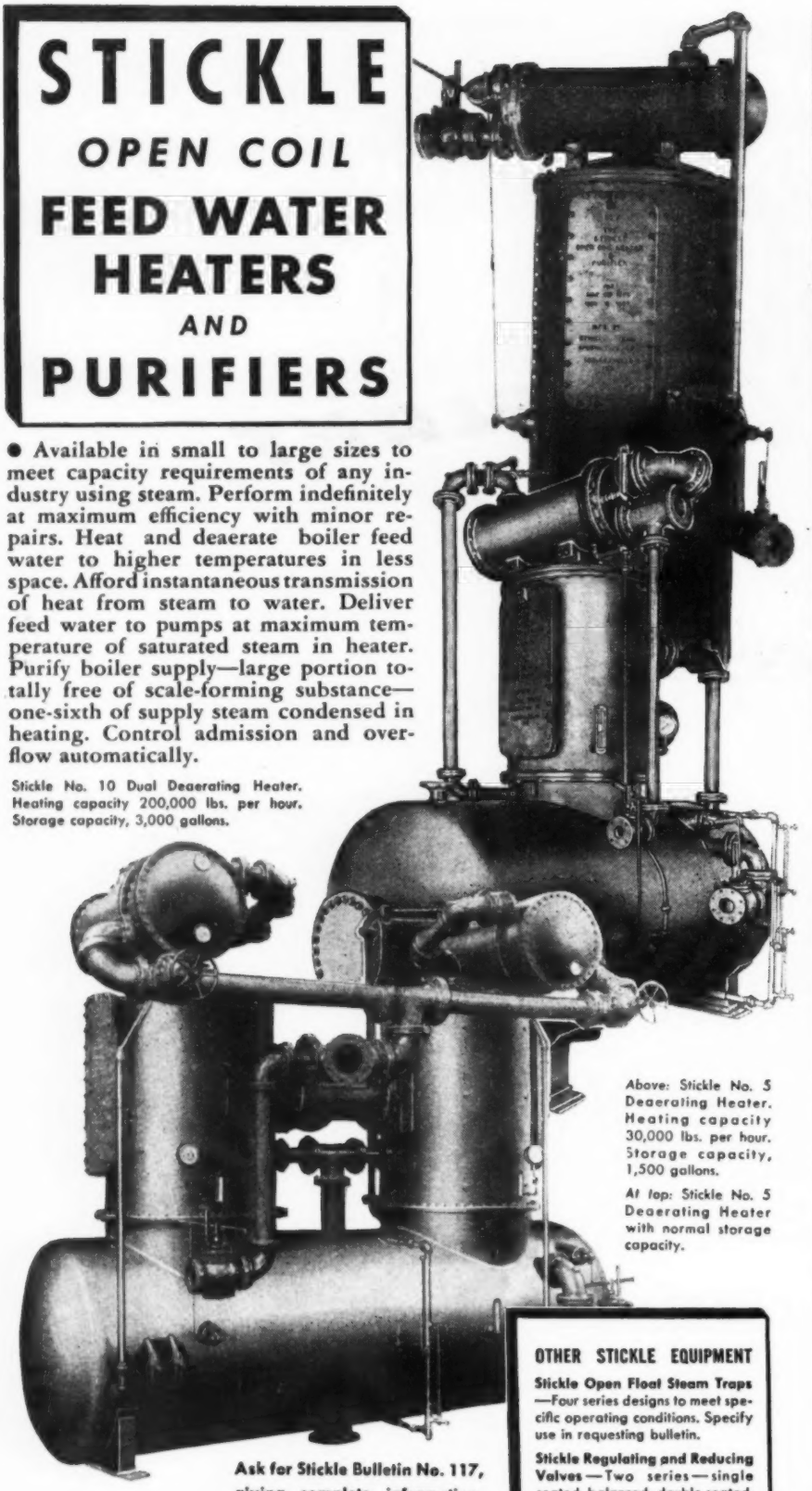
COMPLETE RANGE OF SIZES and thicknesses in blocks and pipe coverings (up to and including 18 inch pipe size in sectional form. Larger sizes in segmental form).

Army-Navy "E" Awarded to FACTORY No. 3 Emeryville, Calif.

Manufacturers of Plant Insulating Materials and Mechanical Packings. Established 1898.

STICKLE
OPEN COIL
FEED WATER HEATERS
AND
PURIFIERS

● Available in small to large sizes to meet capacity requirements of any industry using steam. Perform indefinitely at maximum efficiency with minor repairs. Heat and deaerate boiler feed water to higher temperatures in less space. Afford instantaneous transmission of heat from steam to water. Deliver feed water to pumps at maximum temperature of saturated steam in heater. Purify boiler supply—large portion totally free of scale-forming substance—one-sixth of supply steam condensed in heating. Control admission and overflow automatically.



Stickle No. 10 Dual Deaerating Heater. Heating capacity 200,000 lbs. per hour. Storage capacity, 3,000 gallons.

Above: Stickle No. 5 Deaerating Heater. Heating capacity 30,000 lbs. per hour. Storage capacity, 1,500 gallons.

At top: Stickle No. 5 Deaerating Heater with normal storage capacity.

OTHER STICKLE EQUIPMENT

Stickle Open Float Steam Traps—Four series designs to meet specific operating conditions. Specify use in requesting bulletin.

Stickle Regulating and Reducing Valves—Two series—single seated, balanced; double seated, semi balanced. Each in three standard types. Sizes small to large. Bulletins Nos. 235 and 435.

Stickle Differential Drainage and Boiler Return System—A closed pumping system for increasing boiler capacity and reducing fuel cost. Bulletin No. 250.

Ask for Stickle Bulletin No. 117, giving complete information.

Stickle

STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

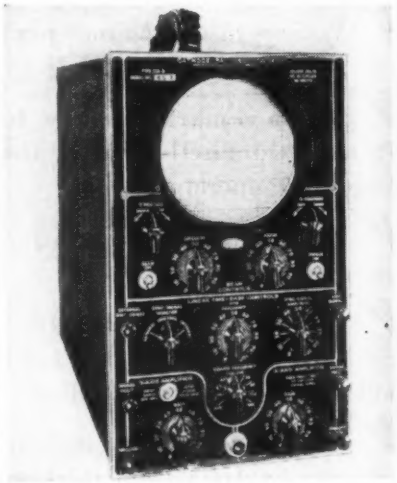
New Equipment

(*Continued from page* 126)

is sealed by reservoir liquid, which is repelled from returning to suction by revolving impeller vanes. During this repelling of reservoir liquid by impeller vanes, there is violent splashing at vane tips.

This action picks up air from the impeller. Air is expelled through diffuser passageways and escapes by bubbling to surface of liquid. Here it is eliminated from the system, while reservoir liquid is returned to impeller tips through same passageways to capture more air. This goes on continuously and rapidly until all air is eliminated. At this time, liquid fills suction line and pumping begins.

A self-priming centrifugal pump can be placed 25 ft above liquid to be pumped, depending on vapor pressure of liquid and barometric pressure. Self-priming centrifugal pumps are built in various sizes, delivering up to 4000 gal per min and developing pressures as high as 150 psi. They are made with gasoline-engine, diesel-engine, electric motor or steam-turbine power, either direct connected or with various belt drives. *Marlow Pumps, Ridgewood, N. J.*

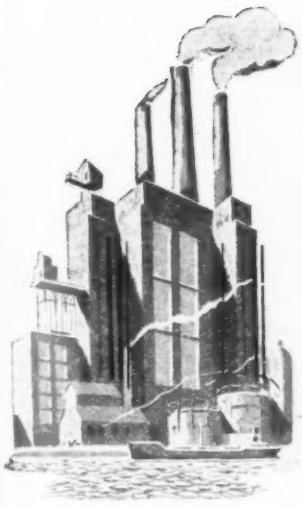


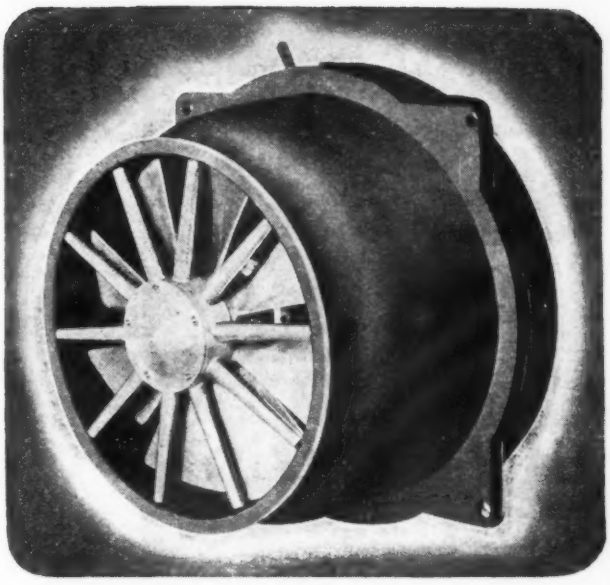
Oscillograph

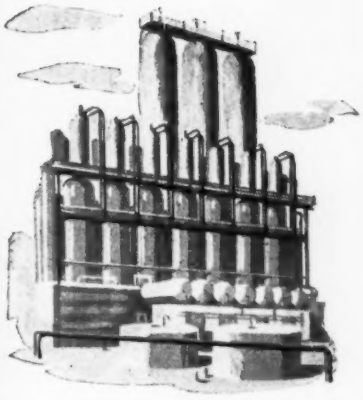
DESIGN CHANGES and refinements have been made in Du Mont 208B oscillographs. Mineral-oil-impregnated, hermetically sealed paper capacitors are used, as well as increased voltage ratings for certain paper capacitors, for greater safety factor. High-voltage wire replaces previous standard wire in high-voltage circuits.

Various changes have been made in the tube complement as follows: negative supply rectifier from Type 17 to Army-Navy preferred Type 6x5GT/G; from the ¼-watt neon tube to the Army-Navy preferred Model 991 voltage regulator for greater stability; from 6F8G tubes to Army-Navy preferred 6SN7GT. Included now is a frequency-range adjustment potentiometer in time base as a factory adjustment, for accurate time-base frequency setting.

For greater mechanical ruggedness there are several refinements, such as addition of

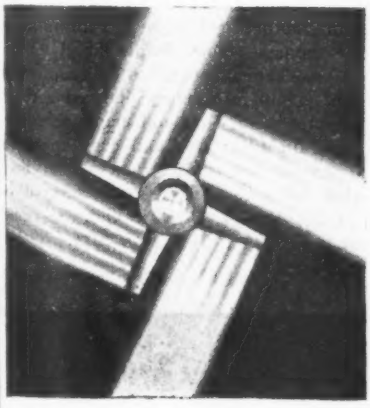






"PINWHEEL ACTION" BURNER

INCREASES BOILER RATINGS



Coppus-Dennis FANMIX Uses New Principle to Create "Flameless Fire" and Get More Heat from Gas or Oil

Greater heat release results from the unique Dennis principle of combining fuel with air in a perfect mixture to provide truly radiant heat — "flameless fire".

On natural gas, for example, FANMIX provides complete combustion with less than 5% excess air in the product of combustion leaving the furnace.

Increase ratings of equipment now operating at limit of present burners. Install FANMIX . . . easily, economically . . . and get more heat.

Coppus engineers FANMIX Burners for individual applications. Complete control over rate of combustion or "flame pattern" can be provided to meet the requirements of any installation. Coppus Engineering Corporation, 103 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

"Pinwheel Action" Gives Perfect Proportioning

Fuel escaping from orifices in rotating driver arms, rotates the fan, which draws in air at right angles to the path of the fuel. The energy in the fuel under pressure is utilized to perform work by mechanically mixing and proportioning the fuel automatically with just the required amount of air.

This homogeneous mixing secures complete combustion. Uniform temperature conditions exist throughout the furnace, with complete absence of drifting "hot spots".

New Installations — FANMIX Cuts Investment Cost

Smaller combustion space — furnace is relieved of having to serve as mixing chamber. Less stack — FANMIX creates its own forced draft, overcoming draft loss across the burner. No forced draft equipment — FANMIX draws air for combustion through air-cooled walls or floors.

2 Types — Straight Gas or Combination Gas-Oil

Combination burners burn either oil or gas in entirety or in any proportion. No oil guns needed.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
165 Park Ave.,
Worcester 2, Mass.

Please send me Bulletin 410-4

New Bulletin Will Tell You How to Increase Thru-Put of Your Gas- or Gas-Oil Fired Equipment.

Name.....

Company.....

Address.....

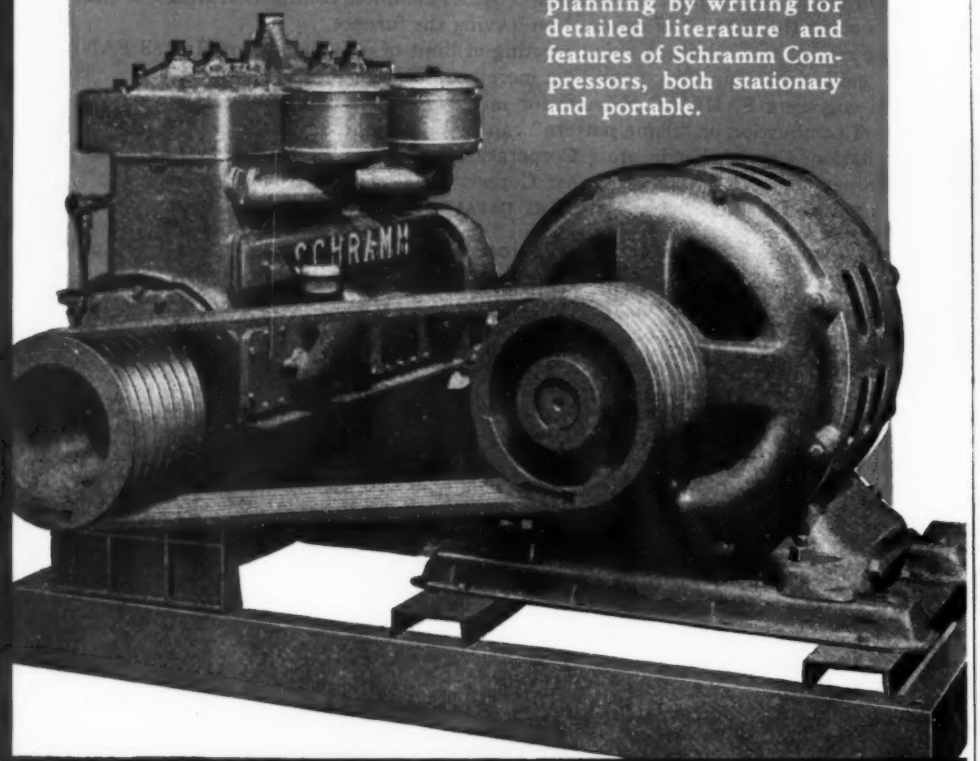
4 REASONS POWER PLANTS SPECIFY SCHRAMM AIR COMPRESSORS

1. 100 PER CENT WATERCOOLED
2. COMPACT—LIGHTWEIGHT
3. MECHANICAL INTAKE VALVE
4. FORCED FEED LUBRICATION

There are many compressed air jobs to be done by Power Plants, and into this versatile picture fits the Schramm Air Compressor. Its features enable compressed air jobs to be done quickly—easily—economically!

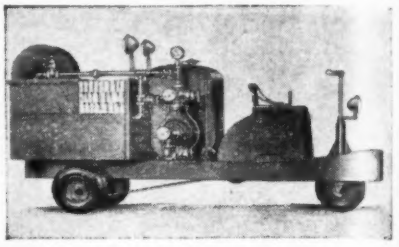
Illustrated here is a stationary unit, one of many types of Schramm Compressors. They are designed for heavy duty, continuous service, with minimum attention.

Schramms are built in sizes ranging from 20 to 600 cu. ft. displacement in every type of mounting and assembly. Start your compressor planning by writing for detailed literature and features of Schramm Compressors, both stationary and portable.



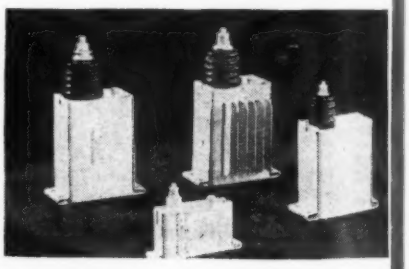
SCHRAMM INC. THE COMPRESSOR PEOPLE WEST CHESTER PENNSYLVANIA

mounting straps on capacitors subject to breakage in transit and tube clamps for tubes subject to jars. A flange is added on chassis assembly to provide extra strength against rough handling. Also better sockets, self-locking stop nuts, rolled bead on cathode-ray tube shield, additional brackets and four bank supports to prevent breakage of banks during rough handling have been included. *Allen B. DuMont Laboratories, Inc, 2 Main Ave, Passaic, N. J.*



Mobile Fire Extinguisher

DESIGNED TO TRAVEL down narrow aisles and to reach fires quickly, mobile fire fighter supplements and often supplants outside help. With its own water-supply tank and 200 ft of hose, this mobile fire extinguisher can smother flames before they become conflagatory. While its own water supply is being used, its 1½-in. fire hose can be connected to a hydrant. Its combination fog or straight-stream nozzle provides for using *fog* for smothering fires with a minimum of water damage. One simple hand control steers mechanism so as to eliminate confusion. Chief advantages claimed for this fire fighter are its unusual maneuverability, self-contained supplies and easy operation. The gasoline-powered truck is a Buda Model *FF Chore Boy*, manufactured by *Buda Co, Harvey, Ill.* Fire-fighting equipment is furnished by *F A B Mfg Co, Oakland, Calif.*

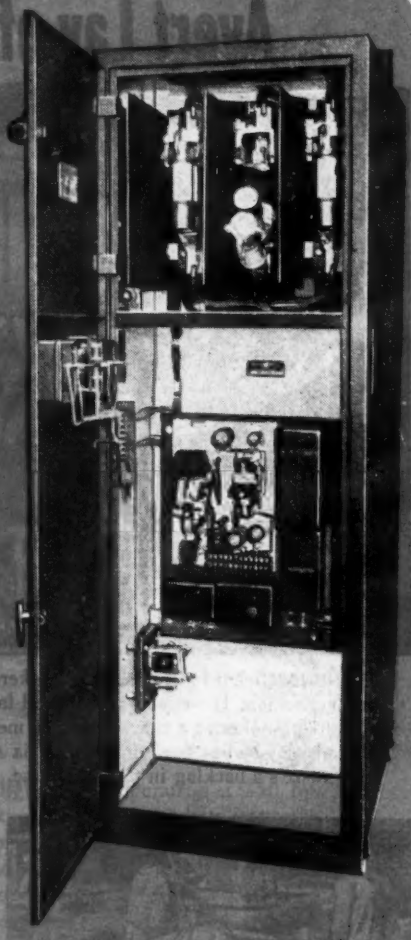


Paper-Dielectric Capacitors

LINE OF HIGH-FREQUENCY paper-dielectric capacitors, in ratings of 5000 to 20,000 v dc, 0.01 microfarad, were developed primarily for grid- and plate-blocking service in electronic-oscillator circuits of high-frequency induction-heating equipment. They can also be used in other high-frequency oscillator circuits of a similar nature. High-voltage paper-dielectric capacitors are of relatively high capacitance for high-frequency units, but they are said to be more economical than conventional high-frequency units of considerably smaller capacitance values.

Internal kraft-paper and aluminum-foil assemblies, compactly arranged and thoroughly impregnated with a low-loss liquid dielectric, are hermetically sealed in rec-

HOW LIMITAMP CONTROL PROTECTS YOUR MOTOR



1/2-CYCLE OPERATION clears high-voltage fault currents before they can do harm

LIMITAMP control, for use with squirrel-cage, synchronous, and wound-rotor motors, provides fast, positive short-circuit protection so necessary for safe operation at high voltages.

Your Motor Is Protected by These Three Limitamp Features

1. **½-cycle Operation**—By means of Type EJ-2 fuses, a rise in current due to a short-circuit is cut off in less than one-quarter cycle, and cleared in less than one-half cycle—long before fault currents can harm your motor.

2. **Efficient Overload Relays**—Accurately calibrated against actual motor characteristics, isothermic overload relays protect your motor from overheating due to sustained overloads, locked rotor, or single-phasing.

3. **Undervoltage Protection**—When there is a low voltage or when power fails, the control *takes the motor off the line,* and the motor will not restart on return of power.

Noiseless in Operation—Limitamp control works silently. Operators are not startled by any part of its operation. Even when a fuse blows, there is no noise. There's only a plainly visible bulge in the end of the fuse.

On voltages up to 4200 volts, the interrupting capacity of Limitamp control makes it the logical answer for any application where high-voltage fault currents are encountered.

A Co-ordinated Control

Air-break contactors, designed to meet the most severe requirements of high-voltage motor-control service, are co-ordinated with the EJ-2 fuses. Because the full short never passes through these contactors, it is possible for them to have a mechanical life of several million operations, and contact-tip life many times that of conventional devices. Bulletin GEA-4247 gives a well-illustrated description of all the features that make Limitamp control tops in the field of high-voltage control. Ask our local office for a copy, or send the coupon direct to General Electric Company, Schenectady 5, N. Y.

Buy all the BONDS you can—and *keep all you buy*

General Electric, Section 676-163
Schenectady 5, N. Y.

I'd like more information about your Limitamp control. Please send me Bulletin GEA-4247.

Name .....

Company .....

Address .....

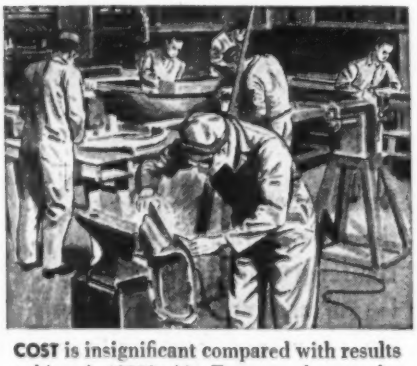
.....

8900

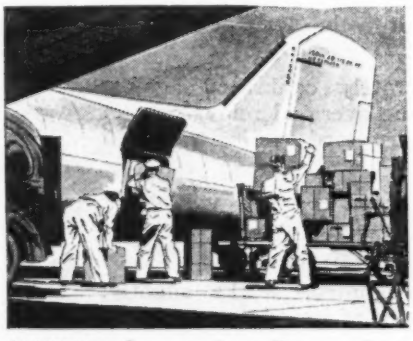
GENERAL ELECTRIC

2-Ton Air Express Shipments Avert Lay-off of 600 men

SIX HUNDRED hard-to-get skilled workers are assembled for an experimental war production job. The supplier of special fasteners needed for the job can deliver only a limited number at a time. Does this mean a lay-off? No. The manufacturer orders a steady day-by-day flow of the units via Air Express to meet daily requirements and until there's a backlog in the warehouse.



COST is insignificant compared with results achieved ($800 Air Express charges for thirty different shipments totaling two tons). Over 600 men are kept steadily at work — to say nothing of avoiding other losses when a war plant shuts down.



SHIPMENTS, large and small, are often delivered *same day* as ordered from points 500 to 1,500 miles away. When time means money, Air Express saves both. Every business can use this *fastest delivery* with economy.

Specify Air Express — Low Cost for High Speed

25 lbs., for instance, travels more than 500 miles for $4.38, more than 1,000 miles for $8.75, more than 2,000 miles for $17.50, at a speed of three miles a minute — with cost including special pick-up and delivery in all U. S. cities and principal towns. Same-day delivery between many airport towns and cities. Rapid air-rail service to 23,000 off-airline points in the United States. Direct service to scores of foreign countries.

AIR EXPRESS

AIR EXPRESS

GETS THERE FIRST

Write Today for "Quizzical Quizz," a booklet packed with facts that will help you solve many a shipping problem. Railway Express Agency, Air Express Division, 230 Park Avenue, New York 17. Or ask for it at any Airline or Express office.

Phone RAILWAY EXPRESS AGENCY, AIR EXPRESS DIVISION

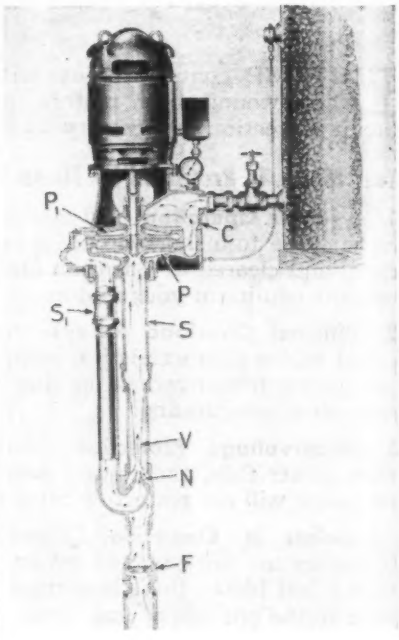
Representing the AIRLINES of the United States

angular metallic cases. A single insulated terminal, provided with a threaded terminal stud, reduces size of case cover and over-all dimensions of capacitor. For the other terminal, a stud is provided for connection to case cover.

Units are supplied with removable footed brackets, which provide for a firm 4-point mounting in any position. The 20,000-v rating is available in two designs—one in a plain case, the other with cooling fins to permit a higher current-carrying capacity. *General Electric Co, Schenectady 5, N. Y.*

Insulated Bushing

DESIGNED ESPECIALLY for thin-wall conduit, SBT insulated bushing is fastened by case-hardened cup-point set screws that bite into conduit and prevent loosening of bushing. It is made in six sizes to accommodate conduit from ½ to 2 in. in dia. Body casting is of malleable iron, cadmium plated. *O Z Electrical Mfg Co, 262 Bond St, Brooklyn, N. Y.*



Two-Stage Jet Pumps

BERKELEY 2-STAGE DEEP-WELL pump is located outside the well. Two impellers P and P_1 are connected back to back and keyed to a stainless-steel shaft which telescopes over motor shaft. Casing of impeller P connects to suction pipe S and pressure pipe S_1 by flanges. Second-stage casing is between the first stage and motor bracket. Chamber C in this bracket has discharge opening at its highest point to a pressure tank and suitable openings for priming and a pressure switch.

After pump is primed and in operation part of water lifted from well enters impeller P_1 and is discharged down pressure pipe S_1 and jet nozzle N. Water passing through jet nozzle creates a partial vacuum at entrance to venturi V to draw water from well through foot valve F. As pressure builds up in tank it also increases on top impeller and therefore on the jet.

Air entrance into suction pipe cannot

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Reports of cleaner Diesels... fewer repairs... time after time...

mean that Nonpareil HD Diesel Oil has something worth looking into if your engines suffer from wartime fuels and heavier loads.

Service records on all types of engines, under every conceivable operating condition—mostly the harder jobs of lubrication and those aggravated by wartime fuels and heavy loads—show that Nonpareil HD has brought cleaner operation in many instances where all previous oils have failed. Just a few examples are briefly described here. Ask the Standard Oil Representative who calls on you where you can see a plant, and talk to the operator who has had similar results from Nonpareil HD.

Nonpareil HD is not only a detergent and oxidation-inhibited oil, but it is outstanding among the few truly heavy-duty oils available for industrial Diesel service. The booklet illustrated here tells why. Send for a copy. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

In a municipal light plant, operating a 750 hp. Fulton engine, there was an immediate improvement in the appearance of cylinder walls after only 370 hrs. of operation on Nonpareil HD Diesel Oil. In addition, only about 1 pound of solids was taken from the centrifuge each 15 hours, whereas 3 to 5 pounds accumulated with previous oils.

The operator of a Model 33 F-M Diesel comments, "Since using Nonpareil HD Diesel Oil, my engine rolls to a stop and rocks slightly, instead of coming to a dead solid stop." A sure sign of less friction and better lubrication afforded by Nonpareil HD!

Two old, 4-cycle Diesels were operated in the power plant of a mid-western cement mill. Because of severe operating conditions and the extreme age of the equipment, ring replacements, and blow-by—which resulted in bearing failure—made down-time and operating time about equal on these engines. It was necessary to pull pistons and break rings loose every 60 to 90 days. In over a year, on Nonpareil HD, the pistons have not even been pulled and no bearings replaced.

Buy more War Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

It was easy to pick the right grease then...

When greasing a wagon or mill wheel was the only lubrication problem, and the principal choice of lubricant lay between bacon rind and axle grease, everyone was his own lubrication specialist. The oak or maple bearings on the old mill wheels could be replaced every winter, if needed. If the grease on wagon wheels became too stiff in cold weather, the horses pulled harder. But horsepower today is more temperamental.

Many factors now enter into the selection of grease: such as types of bearings, bearing clearances, pressures or loads, temperatures, speeds, and the many possible combinations of these. To meet these conditions, there are numerous types and grades of grease, with various oil viscosities, penetration characteristics, and temperature- and water-resistant qualities.

Fitting these many types of grease to the countless jobs requiring grease lubrication in industry is a specialist's work. Standard Oil has such specialists. The Lubrication Engineer in your locality will help you with this problem. He has a wide range of products from which to choose. He's had years of practical experience in applying them.

Why not put your grease lubrication in the hands of the Standard Oil Lubrication Engineer near you? Let him help you start saving horsepower and maintenance *now* for the coming competitive post-war period.

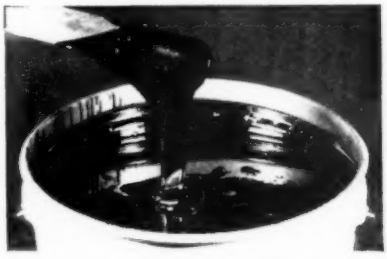
Buy more War Bonds

Cup Grease. Lime soap base, low viscosity oil.

Cup or Pressure Gun Grease. Lime soap base, medium or medium heavy viscosity oil.

Fibre Grease. Soda soap base, medium viscosity oil.

Short-fibre Grease. Soda soap base, medium viscosity oil.



Compound. Usually no soap base, special petroleum stocks.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

A MINIMUM OF OPERATIONS MADE THESE CONNECTORS

THESE electrical connectors are but a few out of the hundreds of types being made today out of Revere copper and copper alloy tube, strip and rod.

Soldering lugs are made of Revere seamless tube, and are finished by simple stamping and punching. Solderless connectors are manufactured of tube, strip, bar and rod. The easy workability of the metal, plus the fact that it is supplied in forms requiring a minimum of operations, make Revere a favorite source of supply.

Other Revere products for electrical purposes include: Electrolytic and silver bearing copper commutator bar and segments; O.F.H.C., silver bearing, and electrolytic copper for armatures and rotors of micromotors and factional h-p motors; Specially Prepared Switch Copper for switches, bus bars and similar applications; Extruded copper shapes for contacts, contact arms, solderless connectors, etc.; Free cutting rod for parts machined to close tolerances; Tubular rivet wire.

The Revere Technical Advisory Service will gladly work with you in studying your requirements and determining the Revere mill products that lend themselves to the most economical manufacture and best service. Just write the Revere Executive Offices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N.Y.

"BALANCED WET BULB" TEMPERATURE CONTROL

U. S. Patent Re-Issue No. 22,533

CONTROL OF TEMPERATURE IN LIQUIDS and GASES

HELPS INCREASE PRODUCTION

U. S. Patent Nos. 2,296,946 and 2,321,933. Re-Issue No. 22,553—Other Patents Pending.

● During the first year of the war, hundreds of installations of the NIAGARA AERO HEAT EXCHANGER were made to assist in war production in various industries.

Many of these installations, which were made primarily because they offered the advantage of saving the cost of cooling water, now show an extra value of great importance in increasing plant production.

Production is increased in three ways: (1) By preventing rejections (2) By permitting quicker starting of every production batch at the correct temperature (3) Your production is faster, due to your *constant* temperature.

Write for illustrated Bulletin No. 96.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. P-55, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

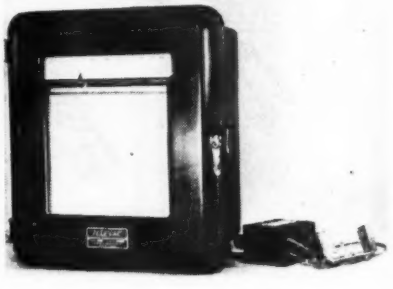
NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

unprime the system because top impeller is not affected by air and thus keeps jet in action to feed first-stage impeller. Maximum capacity is attained at about 25-psi discharge pressure, which is the ideal for water-system service. Capacities range from 5 to 70 gpm. *Berkeley Pump Co, 829 Bancroft Way, Berkeley 2, Calif.*

Lightweight Blower

OPERATING UNDER ALL conditions of climate and temperature, new lightweight blower for heat dispersion weighs 3½ oz and delivers 50 cfm at 8000 rpm. It is available with shaft bores of either .1895 or ¼ in. One-piece housing with aluminum motor plate is 4½ in. from top to bottom. Housings are lightweight high-impact phenolic plastic. Wheels are turbo cadmium-plated steel, available in either clockwise or counter-clockwise rotation. *L R Mfg Co, Torrington, Conn.*

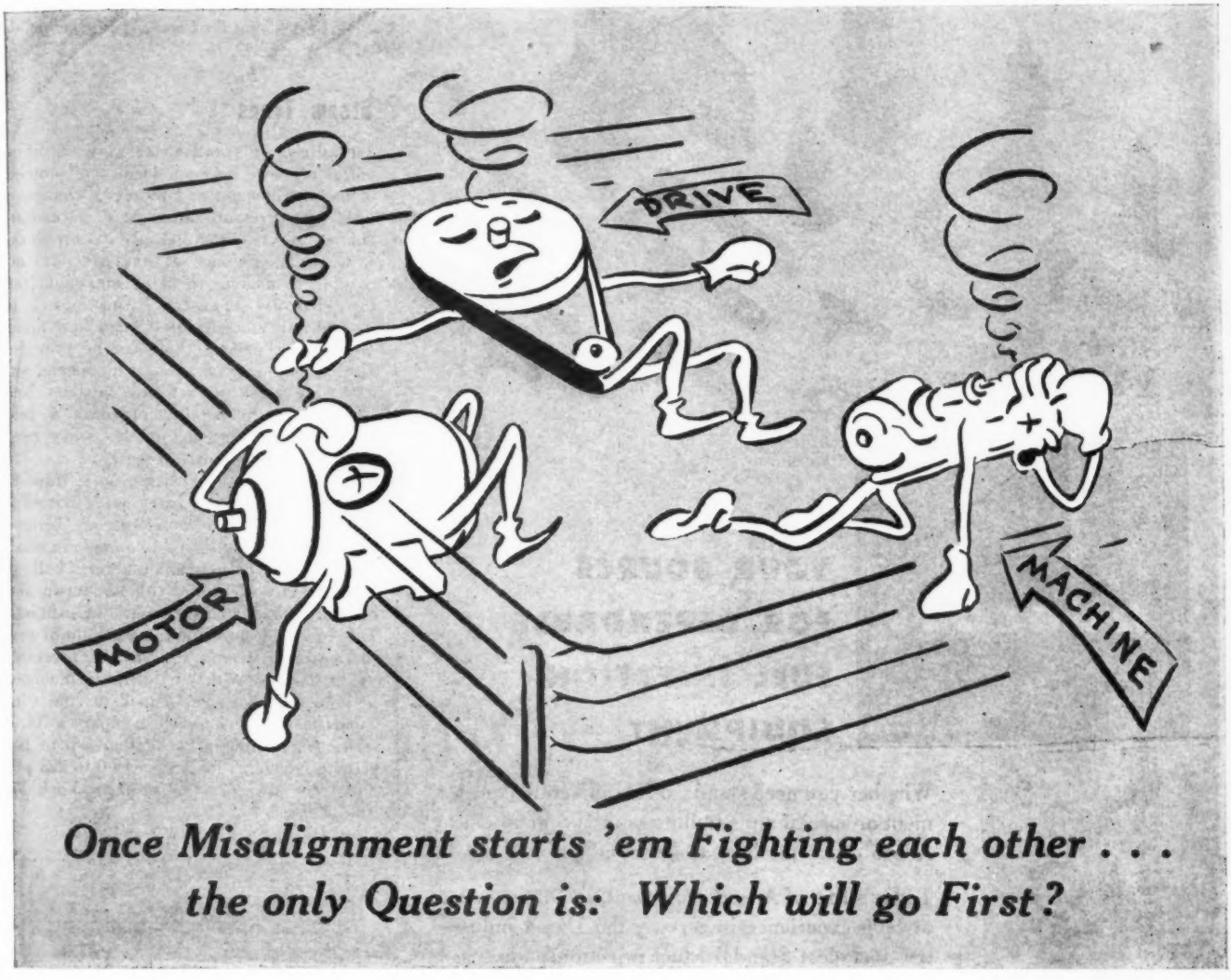


Recording Instruments

MR INSTRUMENT (shown above) with a range of 0 to 500 microns, utilizes new *Televac* No. 500 thermal gage with specially treated elements. Features of latter include coated filaments to prevent off-calibration periods because of water, oil, vapor or other contaminating vapors, increased sensitivity gained through two filaments in both standard and variable tubes of vacuum gage, interchangeability of gages without recalibration and assurance of duplicate readings in terms of absolute pressure in microns. Gage is supplied with a special *Micromax* strip chart recorder calibrated directly in microns.

S recorder for ultra vacuum contains two ranges —0 to 500 microns for pressures above 1 micron, utilizing No. 500 thermal

STOP THIS FIGHT!



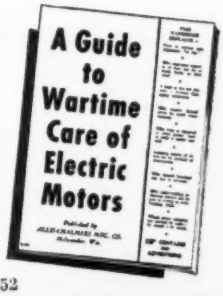
Once Misalignment starts 'em Fighting each other . . . the only Question is: Which will go First?

SPRUNG OR BROKEN shafts, burned-out bearings, overload failure—are cases of motor damage commonly caused by Misalignment. And the damage can occur in drive or driven machine, too. For when these elements are assembled in incorrect geometry, bending, breaking or excessive wear must result. *Something has to "give!"*

Picture above is from Allis-Chalmers' new "Guide to Wartime Care of Electric Motors" . . . which takes a fresh look at Misalignment *and the 8 other main enemies of motor life!*

Over 100,000 copies of this valuable new book are already in use by armed forces and industry. Applies to all makes—contains no advertising. Send for *your* free copy.

ALLIS-CHALMERS, MILWAUKEE 1, WIS.

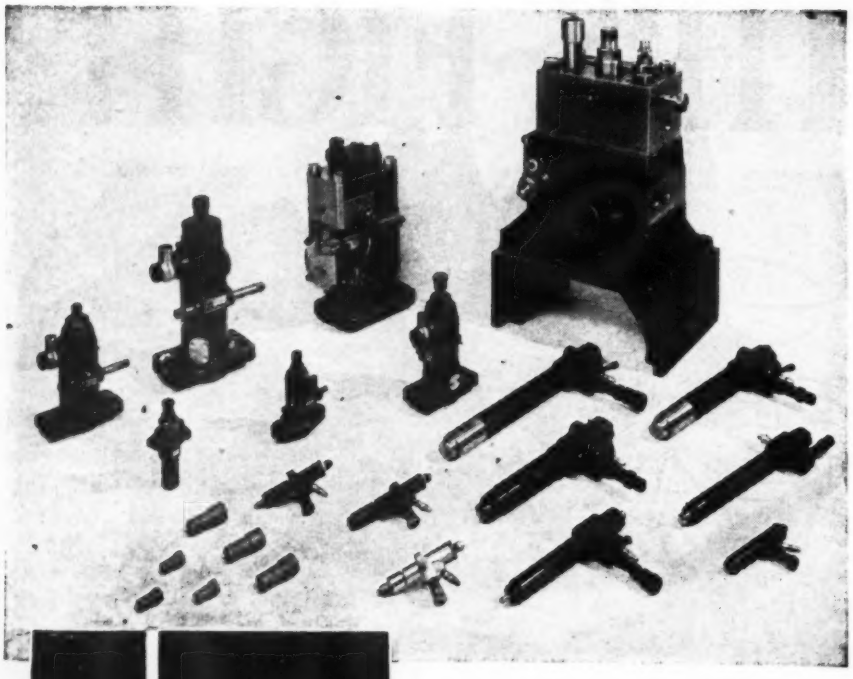


A-1652

ALLIS-CHALMERS MOTORS

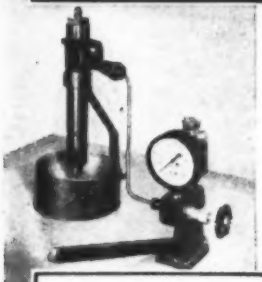
When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

WE WORK FOR VICTORY — WE PLAN FOR PEACE



adeco..

YOUR SOURCE FOR DEPENDABLE FUEL INJECTION EQUIPMENT



Whether you need standard fuel injection equipment or special units built to your specifications, Adeco offers the logical source of supply.

Today's line of Adeco equipment, the outgrowth of long experience in serving the Diesel industry, includes: Standard fuel injection pumps in plunger diameters from 7 mm. to 31 mm.; a complete line of standard nozzles and nozzle holders, including the water-cooled type; and the Adeco nozzle tester.

All Adeco products are built to highest standards, with years of trouble-free operation behind them to testify to their reliability.

ADECO NOZZLE TESTER

For Low-Cost Maintenance

America's most widely used nozzle tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressures up to 10,000 p.s.i. Tests both large and small injectors on bench or engine. Prevents costly delays and possible damage to engine. Standard or Navy-approved gauge. Ideal for testing hydraulic equipment. Write for bulletin.

ADEC

AIRCRAFT & DIESEL EQUIPMENT CORP.

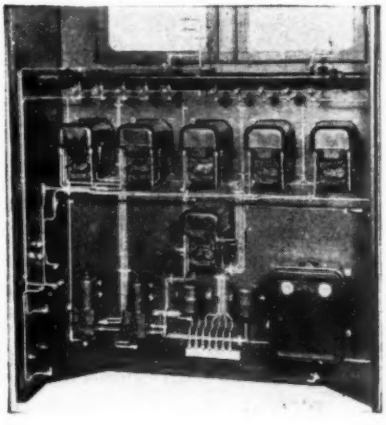
4401 NO. RAVENSWOOD AVE. • CHICAGO 40, ILLINOIS

gage in this range and industrial ionization gage for range 0 to 0.4 micron. It is claimed accurate readings may be obtained down to .001 micron. *S* instrument also features a safety circuit which makes it impossible to turn on ionization gage until a vacuum of 1 micron has been reached. Average life of ionization gage is 3000 hr. *Precision Scientific Co, 1750 N Springfield Ave, Chicago 47, Ill.*

Steam Traps

THERMOSTATIC STEAM TRAPS work on differential pressure between inside and outside of bellows element and therefore change in operating pressure does not necessitate change of valve seat. A given trap works with equal efficiency at any pressure, according to maker, up to its maximum rating. Because of great lifting power of thermostatic element, these traps have much larger valve orifices than can be provided on float or bucket models. This means several times the air-venting capacity and therefore rapid heating up from a cold start. When installed outdoors, they need no protection against freezing.

In the past, use of thermostatic traps at pressures above 50 psi had been restricted to small equipment because flexible bellows of sufficient strength could be made in small sizes only. Sarco now manufactures bellows from heavy-wall bronze tubing, drawn and helically corrugated by their own methods. This has made possible introduction of new thermostatic steam-trap line for pressures up to 225 psi with single, large diameter bellows for inlet sizes ½ to 2 in. and with capacities double these of company's No. 9 series. No. 9-100 is for pressures 0 to 100 psi and No. 9-225 for pressures 0 to 225 psi. *Sarco Co, 475 Fifth Ave, New York 17, New York.*



Boiler Control Panel

PREFABRICATED BAILEY boiler control panels include all necessary connecting piping and electrical wiring for operation of metering equipment and boiler control systems. All piping and wiring necessary for operation are installed as a unit according to a coordinated and prearranged plan, instead of as piecemeal operations by various contractors in field.

Small units, such as valves, relays, switches, signal lights, and the sturdier and lighter-weight instruments, are mounted

DARLING SUPER-MACHINED SURFACES—
Another Reason for No Leakage at Any Pressure!
A Simple Ten-Second Test Shows What Super-Machining Really Is..
Mirror Finish Seating Surfaces
Mirror Finish + Wedging Action = LEAK-PROOF VALVES
MS UP TO THE Fact THAT

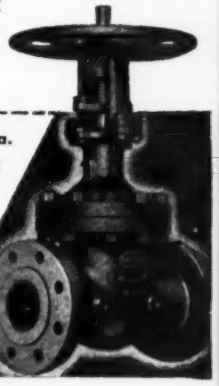
Let This "X-Ray" Give You the Inside Story of Valve Values

LITERALLY hundreds of valve users—engineers, superintendents, maintenance men, purchasing agents—have exclaimed on seeing it, "Where has this valve been all my life?"

For this "X-Ray" shows you the inside story of the Darling Valve—the unique gate valve with the fully revolving double discs and parallel seats. It shows why Darling's unique design permits the gate to adapt itself to out-of-line positions of the valve seats; caused by line strains, high temperatures and pressures which distort the body of any valve.

Seeing this demonstration, you quickly visualize just why the Darling Valve gives you (1) tighter closing, (2) easier operation, and (3) longer life.

So let the Darling man X-Ray Valve Values for you when he calls. To bring him immediately, if you've a valve problem right now, just drop us a line, or wire, or phone us.

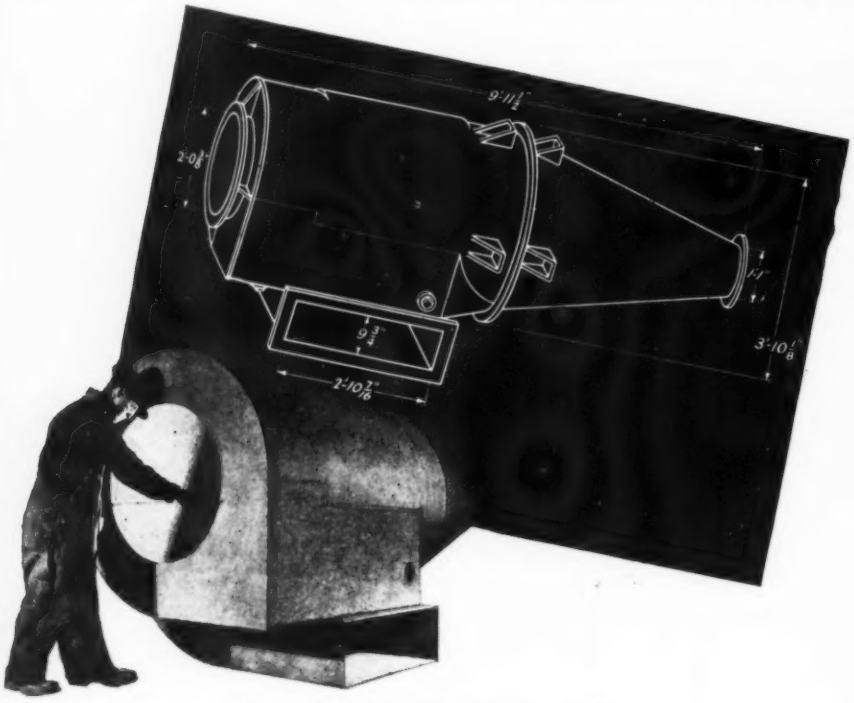


DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

Darling Valve & Mfg. Co., Dept. E, Williamsport, Pa.
Gentlemen: I want to know more about Darling valves. Please send your Catalog.

Name .....
Company .....
Address .....
City ..... State .....

LARGE DIAMETERS



Buell's assurance of
HIGH EFFICIENCY, LOW MAINTENANCE, LONG LIFE

THE DECIDED ADVANTAGES of Buell's large diameter cyclones, made possible by the patented "Shave-Off", definitely reflect industry's growing preference for Buell (van Tongeren) Dust Recovery Systems.

Large diameters make possible a collection operation with low centrifugal force and permit construction of extra thick steel. This accomplishes two things: minimum abrasion and long life. *Large diameters* afford large dust outlets, making clogging practically nil. *Large diameter* cyclones have the added advantage of handling a given gas volume with fewer units.

Engineers who look to low cost up-keep and continuous operation as prime requisites in dust recovery should give these factors serious consideration.

BUELL FEATURES

SHAVE-OFF
LARGE DIAMETERS
EXTRA-STURDY CONSTRUCTION
CORRECT HOPPER DESIGN
SPLIT-DUCT MANIFOLDS
INNER WELDS GROUND SMOOTH

RESULT IN

HIGH COLLECTION EFFICIENCY
LESS FAN BLADE WEAR
LOW DRAFT LOSS
LOW POWER CONSUMPTION
HIGH TEMPERATURE RESISTANCE
UNLIMITED CAPACITY
NO MOVING PARTS
FREE DUST FLOW

PRODUCE

HIGH EFFICIENCY
LOW MAINTENANCE
LOW OPERATING COST
LONG LIFE
NO CLOGGING

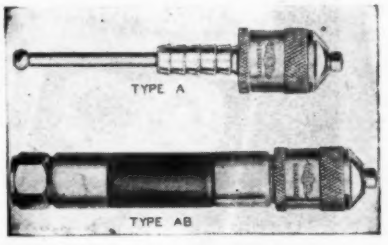
buell
DUST RECOVERY SYSTEMS

Engineers and plant executives are invited to write for Buell's factual 28-page book:
"The van Tongeren System of Industrial Dust Recovery"

BUELL ENGINEERING COMPANY, INC.
10 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

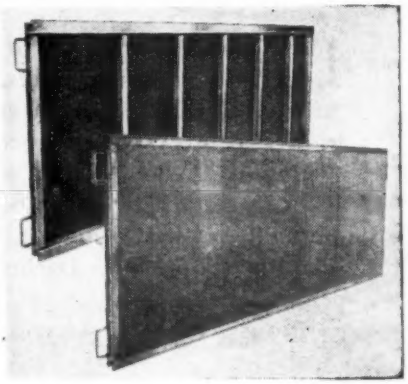
and connected ready for service. Heavy instruments or instruments having delicate mechanisms are shipped separately, but cut-out spaces, drilling and all necessary connections are provided so that installation in the field is quick and easy. Connecting piping and electrical wiring are brought to convenient terminals, which are carefully tagged so that no time or effort is lost in connecting the prefabricated boiler control panel to various factors which it controls. *Bailey Meter Co,* 1050 *Ivanhoe Rd, Cleveland* 10, *Ohio*



Air Guns

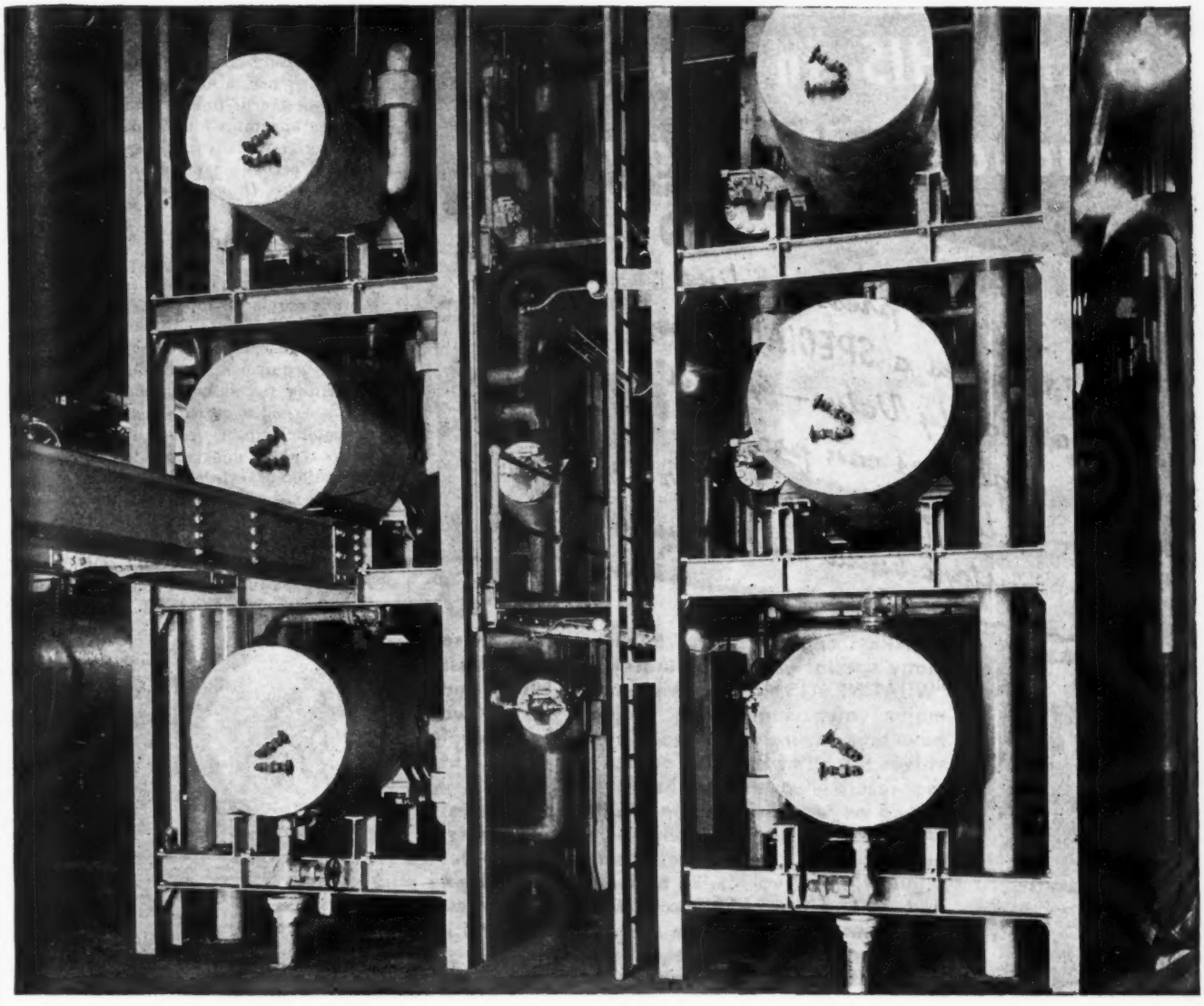
LEAKPROOF AIR GUNS blow chips, dust, dirt, eject finished parts and operate air-driven tools, such as air vises, clamps, chucks, presses, etc. A slight fingertip flex of hose discharges a small puff or full blast of air as desired. Operation is instantaneous and positive, according to maker, effecting substantial savings in air, power and compressor maintenance costs. Streamlined design eliminates levers, buttons, gaskets or glands. Patented ball-and-socket valve joint has only two moving parts. Air pressure helps close valve tightly when fingertip pressure is released.

Type *A* is most popular style for permanent applications. Type *AB* is for remote control applications. It is attached directly to air pipeline and operated by hand, knee or foot control, pulleys, etc. Guns are in three styles, for complete range of hose diameters. *Trico Fuse Mfg Co,* 2948 *N 5th St, Milwaukee* 12, *Wis.*



Stainless-Steel Screen

UNIT IS LIGHTWEIGHT and easily removed for quick cleaning. Stainless steel is used throughout in screen construction to assure maximum resistance to corrosion. Screen is for all kinds of process water. Screen face is fine-mesh stainless-steel wire fabric, which is backed up by a heavy gage screen of about 1-in. sq mesh. Behind this backing are horizontal back struts of frame itself,



Huntley Station Equipped with ALCO High-Pressure Feedwater Heaters

Buffalo Niagara Electric Corporation plant-installation shows interesting features

THIS PHOTOGRAPH, showing shell-cover end of six ALCO High-Pressure Feedwater Heaters installed in Huntley Station of Buffalo Niagara Electric Corporation, gives emphasis to several unusual features.

Outstanding is the fact that the heaters are stacked three high and that the shells are fitted with rollers.

This installation is further evidence of the trend toward ALCO heaters in high-pressure steam-plant practice. Several ALCO installations are operating successfully at 2200 lbs. pressure.

ALCO Bulletins describing and illustrating this equipment will be sent promptly on request. You are cordially invited to consult ALCO engineering specialists in connection with any feedwater-heater and heat-exchanger problem.

American Locomotive

ALCO PRODUCTS DIVISION

30 Church Street, New York 8, N. Y.
Dunkirk, N. Y.

Paste THIS in your handbook, Mr. Engineer!

IF your pressure line requires a SPECIAL Relief or Safety Valve—Farris engineers can provide the proper valve, or custom build one for you!

FARRIS Handwheel Relief Valve No. 1450, for frequent changes of relief pressures. Special construction to withstand excessive wear of continual adjustment. Sizes ½" to 8"

FARRIS Safety Relief Valve No. 2175. Full nozzle port, hi-lift. Steam Separator Bell. Pressures to 600 lbs. at 750° F. Sizes ¾" to 6".

FARRIS engineers have been called in on so many special valve jobs that we often wonder "WHAT NEXT!" Minor pressure technicalities and major valve engineering projects alike — we have built accurate, dependable safety and relief valves for *all* of them. Of course we're proud of that record—we are only human!

And as we designed and built those special FARRIS valves for new industries, new processes, new products . . . we added most of them to our regular line of valves. So today, it's a good bet that among the FARRIS collection of all types, sizes, and metals, there is *the very valve* which will exactly meet your requirements.

But if WE have *any* doubt about that, we will *custom build a valve especially for your job.* And we'll be glad to do it, because we may find that we can add your new FARRIS valve to our already extensive line . . . so we'll mutually benefit from your problem!

Now, don't you agree . . . that makes good business sense? *Why not write today for our Specifications Bulletin?*

FARRIS ENGINEERING COMPANY
366 Commercial Avenue, Palisades Park, N. J.

Write us today about any Safety or Relief Valve Problem confronting you. If you are lucky and do not have a valve headache now, GOOD! But paste this ad in your handbook for future emergencies.

Farris

SAFETY and RELIEF VALVES

which provide maximum resistance to bellying and buckling of fine strainer under water pressure. Available in any dimension desired, it may also be supplied with specially designed frames and quick-acting hoisting apparatus for removing frames for cleaning, especially in larger sizes where removal becomes a problem. *Rodney Hunt Machine Co, Orange, Mass.*

Vibration Control

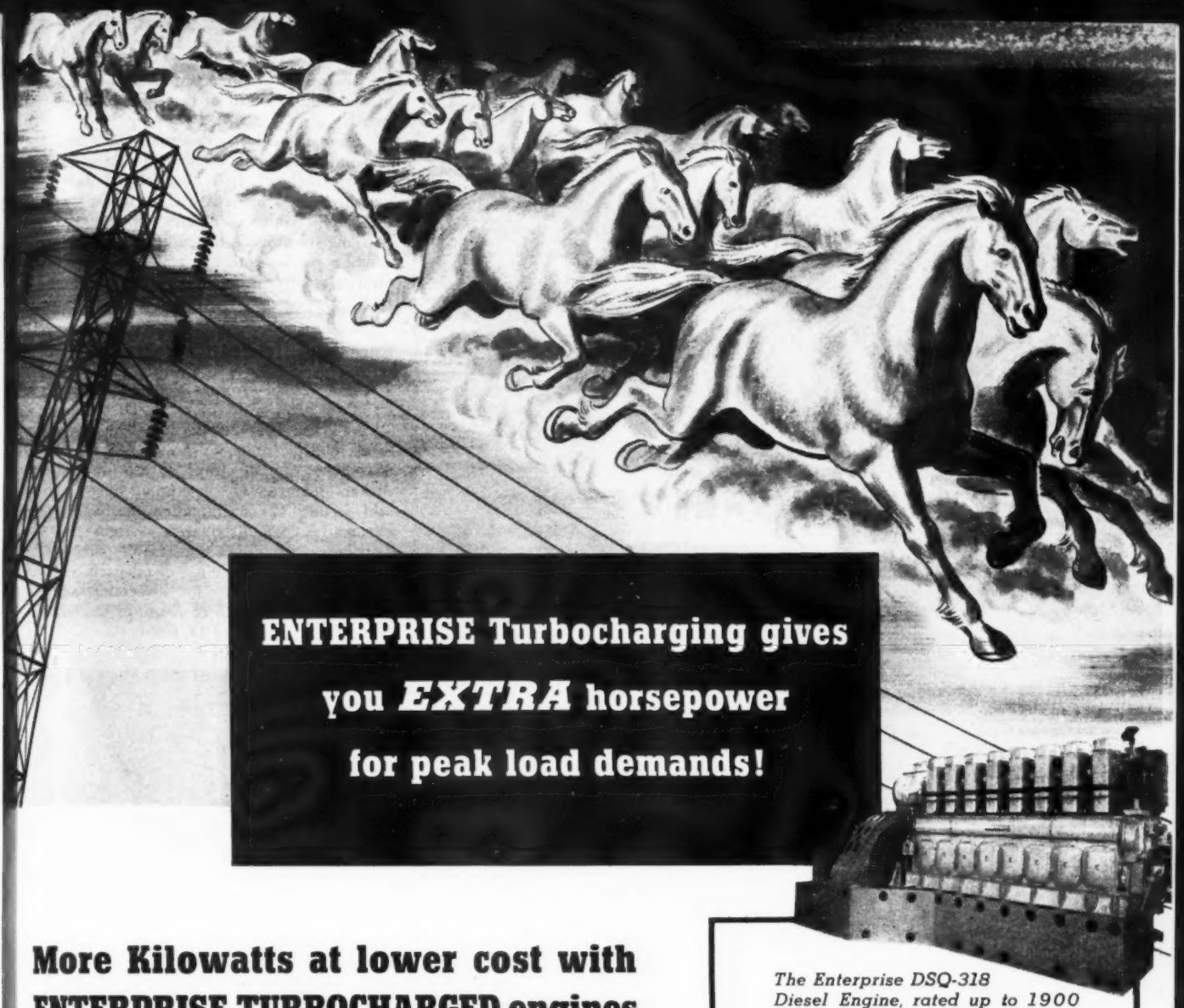
SL UNIVERSAL VIBRO-ISOLATOR absorbs vibration from all directions, which makes it an effective vibration control for diesel engines, generators, panelboards, material-testing equipment, recording apparatus, ventilating and air-conditioning equipment, etc. It is said to be particularly effective in cushioning impacts from all horizontal directions where unbalanced forces, centrifugal action or external belt pulls are encountered. Load capacity of the six sizes ranges from 200 to 12,000 lb. Adjustable steel springs for the control of vertical vibration are combined with self-adjusting isolation members for control of lateral vibration. *Korfund Co,* 48-15 32*nd Pl, Long Island City* 1, *N. Y.*

Detachable Flange

FOR HELICAL FLEXIBLE metal hose, in sizes 2, 2½ and 3 in. ID, *A-F* detachable flange is designed for repeated reuse. Assembly operation, with ordinary shop tools, is simple and time-saving. No brazing is required. No gasket is employed to connect flange to hose, thus making a metal-to-metal seal. Construction is said to insure a positive leakproof installation. *Packless Metal Products Corp, New Rochelle, N. Y.*

Radiation Pyrometer

FIVE MAJOR IMPROVEMENTS, just introduced in *Radiamatic,* make this compensated radiation pyrometer secure against air and gases up to 1-psi pressure at temperatures up to 250 F: (1) Adhesive sealing compound is between lens and mounting ring. (2) Brass is utilized for lens retaining and mounting rings. (3) Controlled torque is applied when assembling lens retaining and mounting rings. (4) Two spanner wrench holes in lens mounting ring face have been replaced with a milled slot which avoids cutting through ring face. (5) Improved adhesive gives a more positive sealing of sighting glass located in rear of thermo-



ENTERPRISE Turbocharging gives you *EXTRA* horsepower for peak load demands!

The Enterprise DSQ-318 Diesel Engine, rated up to 1900 HP at 360 RPM... one of the fifteen Enterprise Turbocharged models

More Kilowatts at lower cost with ENTERPRISE TURBOCHARGED engines

The problem of fluctuating bus bar demands can be solved the modern, low-cost way... the Enterprise way.

No matter how long peak demand periods last ... hours...days...weeks...Enterprise Turbocharged Diesels give you 50% or more power than ordinary engines.

Enterprise Turbocharged Diesels harness previously-wasted exhaust gases to give you *extra* power. Enterprise Turbocharged Diesels consume less fuel and oil ... require less maintenance for normal demands or to deliver full rated power for peak load performance. Your cost per kilowatt is lower.

Write today for Enterprise Catalog No. 192 . . . telling the interesting story of Enterprise Turbocharging, and how it can be applied to your specific needs. Address Department P-1.

Enterprise Turbocharged and Non-Turbocharged engines... operating on Diesel oil or heavy oil... producing more kilowatts per pound of fuel

ENTERPRISE TURBOCHARGING Gives You ALL These Benefits:

1. **TURBOCHARGING . . .** harnesses previously-wasted exhaust gases for extra power.
2. **MORE POWER** per cubic inch displacement.
3. **LOWER UPKEEP COST...** require less service, no hand-oiling or adjustment.
4. **LOWER FUEL COST**
5. **SAVES SPACE...** more power in less space.
6. **SAVES WEIGHT...** more power per pound of weight.
7. Engineered for your application by specialists in Diesel design.

SINCE 1888

ENTERPRISE ENGINE & FOUNDRY CO.

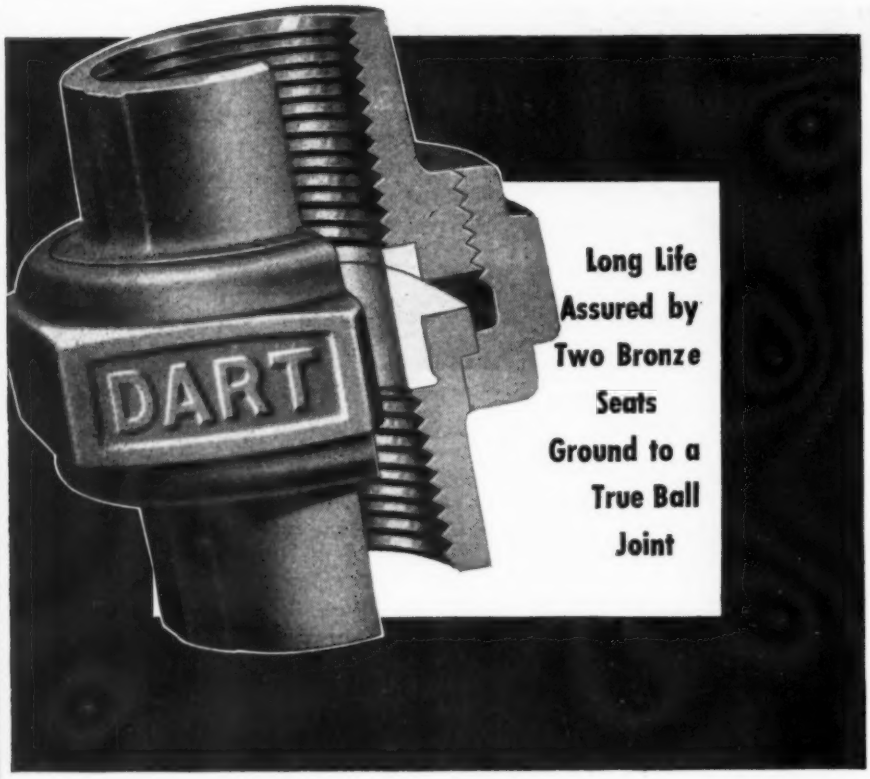
18th & FLORIDA STREETS — SAN FRANCISCO, CALIF., U.S.A.

Cable Address: Enterfound

Enterprise DIESEL POWER

DARTS

ARE LONG-LIVED



Dart Unions live longer because their two bronze seats meet in a true ball joint—effect a leak-proof connection without ruinous wrenching. They may be uncoupled instantly for use wherever else they may be needed.

Body and nut—made of high-test air-refined malleable iron — are practically unbreakable. Longer lasting, Darts cost less in the long run. Tell your supplier to send you Darts.

Dart Unions Live Longer

DART UNIONS

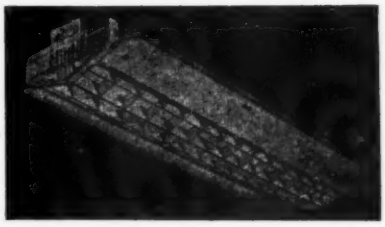
E. M. DART MFG. CO. PROVIDENCE 5, R. I.

pile assembly. Another improvement is use of aluminum instead of cast iron for housing.

Radiamatic consists essentially of a heat-resisting lens, compensator and thermopile. Energy radiated from hot object being measured falls on lens and is focused on thermopile which generates an emf proportional to object's temperature. Measurements are independent of ambient temperatures. *Brown Instrument Co, Philadelphia, Pa.*

Spreader Stokers

J & J SPREADER STOKERS are built in four standard sizes, with rotors 16, 20, 24 and 32 in. long. They can be installed singly, or as multiple units, to meet requirements of boilers ranging from 75 hp upward. Stokers feature: (1) leakproof dust-tight coal feeder, (2) combination mechanical-pneumatic coal distributing system that distributes lumps and fines to all parts of grate area, (3) air cooling of all parts and (4) easy accessibility for inspection and maintenance. *Johnston & Jennings Co,* 877 *Addison Rd, Cleveland* 14, *Ohio*



Fluorescent Fixture

EGGCRATE ARISTOLITE, for four 40-watt fluorescent lamps, combines lamp shielding and glass diffusion in same fixture. It is said to provide strong, efficient down lighting through *Eggcrate* louvers, plus diffused side lighting through glass panels. *Eggcrate Aristolite* has paneled and die-cut ends, which afford pleasing light-window design. Glass panels and *Eggcrates* are removed separately for easy maintenance. Fixture is for individual or continuous installation and can be suspended from or mounted directly to ceiling. *Edwin F Guth Co,* 2615 *Washington Ave, St. Louis* 3, *Mo.*

Level-Lift Slings

FORMERLY ONLY in 3- and 6-ton capacities, Macwhyte *Caldwell* level-lift slings are now made in ¾- and 1½-ton capacities also. Operation is simple. After lightweight block containing wire rope is put on crane hook, operator spots crane hook over approximate center of gravity of load and floormen attach sling to load. Operator then applies power to lift load and, as crane hook is lifted, rope automatically adjusts itself through *level-lift* block. One sling leg of rope then becomes longer than the other, and as weight of load pulls on wire rope, sheave in block pulls down against brake which prevents slippage. Load is then lifted level.

If operator does not get the block and crane hook close enough to center of gravity of load, it is only necessary to lower load enough to relieve tension on sling, which re-

STRENGTH

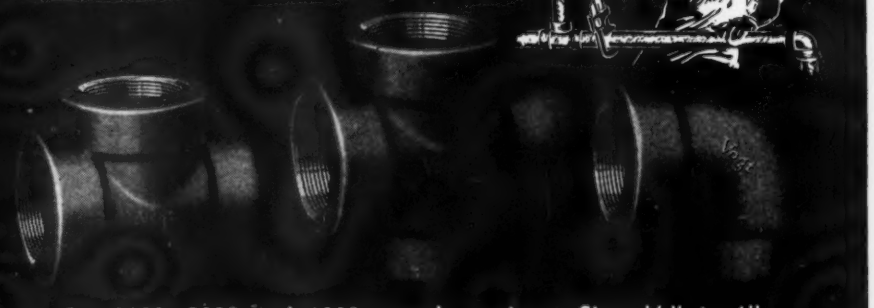
FOR SAFETY AND LONG-TIME SERVICE

Specify

Vogt

DROP FORGED STEEL FITTINGS

SCREW END TYPE



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SOCKET WELD TYPE

For schedules 40, 80 and 160 pipe — Sizes 1/8" to 6"

Round-the-clock operation of oil refineries, chemical plants, steam plants, etc., essential to the continuous flow of war products to the United Nations, is all in the day's work for these fittings. Today, as in peacetime, Vogt drop forged steel fittings make a major contribution to the efficient functioning of pipe lines in plants vital to the war effort.

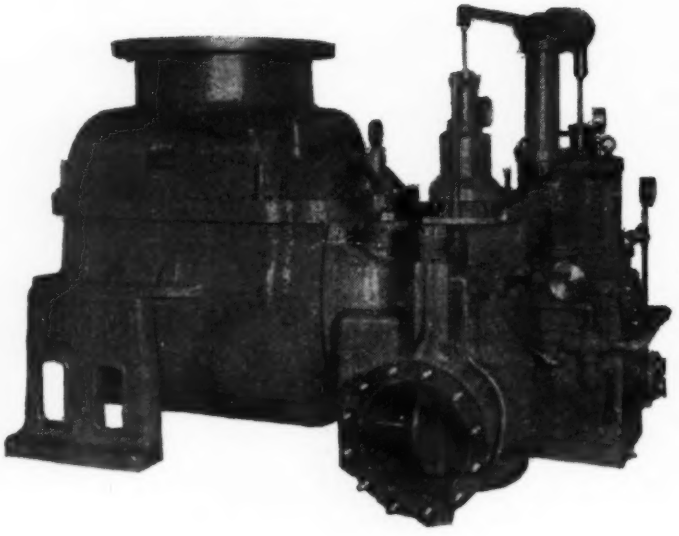
Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy.

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KY.

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

MURRAY
MULTISTAGE
STEAM TURBINES



Another MURRAY multistage steam turbine, designed to deliver 350 horsepower on low pressure steam at 5 pounds and exhausting to 26 inches Hg vacuum. It is provided with single inlet valve with 10 inch flange, and 24 inch exhaust facing up. This unit will pay for itself in a short time, since it utilizes what would otherwise be wasted energy, since an excess of low pressure steam existed.

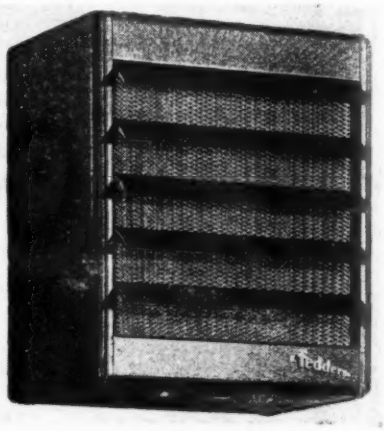
Equipment includes variable speed oil relay governor, butterfly type emergency trip valve, strainer surrounding the double seated balanced governor valve.

The complete MURRAY line of turbines includes all variations of mechanical drives, and turbine generator sets up to and including 2500 KW rating.

Sales Representatives for Murray products are located in all principal cities.

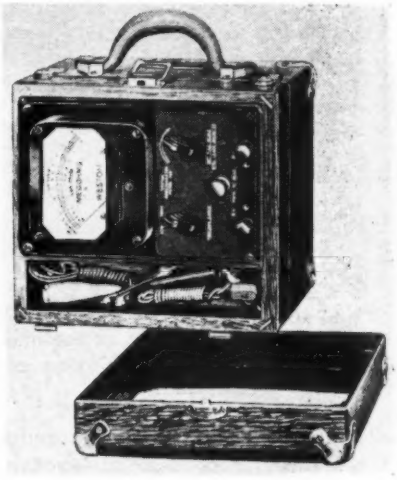
MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

releases brake, and then move the crane hook over to true center of gravity. On applying the power, ropes readjust themselves and load rises level. *Macwhyte Co, Kenosha, Wis.*



Unit Heaters

OUTSTANDING FEATURE of Fedders Series 15 unit heaters is the design of the deep brazing flanges, which are extruded into the headers. They provide unusually abundant area of contact between tubes and headers. Heaters have streamlined copper tubes and fins. Complete relief of expansion stresses is provided between heating element and cabinet, as well as between adjacent tubes. Quiet, broad-blade fans, large Btu capacity and low final temperatures are said to provide maximum distribution and comfort in working zone. Line is built in ten sizes, ranging from 100 to 1000 edr capacity with corresponding 24,000- to 240,000-Btu capacity. *Fedders Mfg Co, 57 Tonawanda St, Buffalo 7, N. Y.*



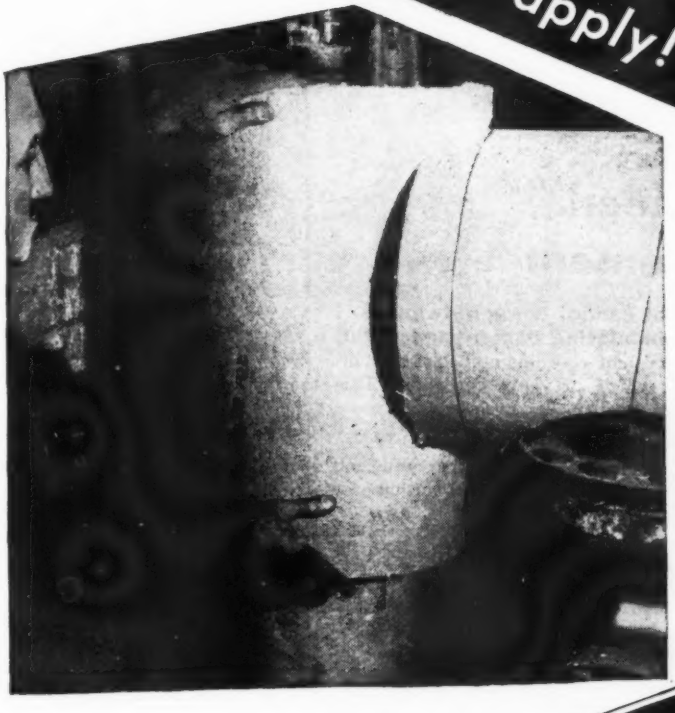
Insulation Tester

MODEL 796 DIRECT-READING insulation tester provides complete insulation and resistance tests up to 200 megohms at a test potential of 350 to 500 v dc. Instrument eliminates necessity for crank turning. Leakage tests can be made in cramped quarters or other hard-to-get-at places. Operator always has complete freedom of both hands. Although test potential is 500 v at terminals, current is only a few microamperes, thus making

GETTING "HOT UNDER THE COLLAR"?

SIMPLY APPLY UNIBESTOS

it's simple to apply!



It's easy to cover flanges and fittings with Unibestos, the sectional insulation. Unibestos saws or cuts clean and sharp with ordinary tools—no mess. Here's how it's done: bring adjacent pipe covering up to proper level by use of a collar of a standard section of Unibestos and then simply span both flanges with a single piece of sectional Unibestos properly cut to fit. That's all there is to it!... and you have a smooth, neat, efficient and readily-removable installation.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

ARMY ARMY E NAVY

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

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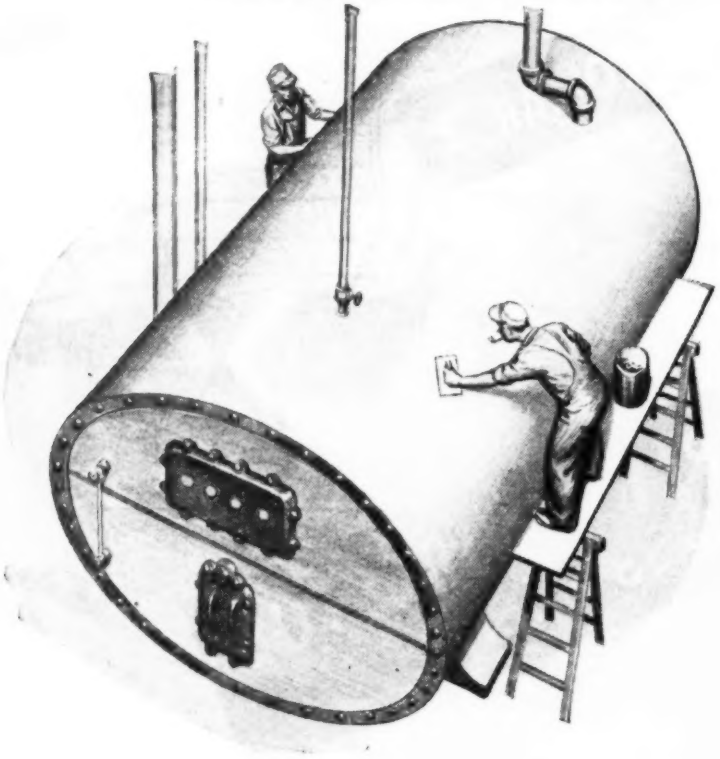
UNION ASBESTOS AND RUBBER CO.

*CONSIDER *these 6 facts*



*when you need an insulating cement

1) B-H No. 1 Insulating Cement is efficient over the full range to 1800° . . . because a special processing of high-temperature-resisting nodulated Baldwin-Hill *black* rockwool and other ingredients provides complete retention of the cement's physical characteristics. It will not form a homogeneous mass.

(2) B-H No. 1 Insulating Cement assures a permanent bond — whether applied on a hot surface and dried instantly, or slowly air-dried over a period of time.

(3) Rust cannot come between B-H No. 1 Insulating Cement and metal, as the cement contains a special rust inhibitor which prevents corrosion. This feature reduces costly replacements.

(4) No peeling or cracking—B-H No. 1 Insulating Cement retains sufficient elasticity to absorb normal expansion and contraction.

(5) Easily applied without skilled labor. Simply mix with water, and trowel on.

(6) 100% reclaimable up to 1200°.

Write for a practical sample and complete data.

For one-block insulation—at all temperatures up to 1700° F.—write for illustrated data on MONO-BLOCK.

Address: **Baldwin-Hill Co., 575 Klagg Ave., Trenton 2, N. J. Plants in Trenton, N. J.; Kalamazoo, Mich.; Huntington, Ind.**

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

it impossible for operator under normal conditions to receive any harmful shock. Tester operates from self-contained lightweight batteries and has no vibrators or tubes to replace. *Weston Electric Instrument Corp, 617 Frelinghuysen Ave. Newark 5, N. J.*

Air Control

ASHCROFT AIR CONTROL, of shallow-well design, is for water-storage tanks of shallow-well pneumatic water systems. Durable rubber diaphragm is the single moving part which combines valve head, gland seal and float hinge. Valve with stainless steel orifice is completely sealed from corrosion or tampering. It has no water cavities. Body is either cast brass or cast iron. Unit is compact, lightweight and measures 1¾ in. between wrench flats. Control is for applications up to 80-psi tank pressure. *Electro-Mechanical Div, Manning, Maxwell & Moore, Inc, Bridgeport 2, Conn.*

Low- and High-Pass Filters

HPI HIGH-PASS and LPI low-pass interstage filters have a primary impedance of 10,000 ohms, designed to operate from the plate of a triode tube. Units employ a dual alloy magnetic shield, which reduces inductive pickup to 150 mv per gauss. Dimensions in hermetically sealed cases are 1½x 2½x2½ in. They can be supplied for any cutoff frequency from 200 to 10,000 cycles. *United Transformer Co, 150 Varick St, New York 13, N. Y.*

Electric Speed Indicator

CONSISTING OF TWO UNITS, electric speed indicator gives readings of speeds from 100 to 5000 rpm. Pickup unit, a miniature 6-pole alternator with a permanent magnet rotor, is mounted on shaft whose speed is to be measured. Permanent-magnet moving-coil indicator meters pickup output on a 3¾ in. scale, which covers 95 deg of arc. Resistance of indicator has been made sufficiently high so that size or length of leads connecting the units has no effect on accuracy. Indicator may be located at any distance from pickup unit.

Instantaneous and continuous speed in-

Prepared for ACTION!

YOU'RE SURE TO GET TOP-FLIGHT DRIVE PERFORMANCE WHEN YOU SPECIFY ALLIS-CHALMERS TEXROPE V-BELTS . . . EACH BELT IS DESIGNED, TESTED AND BUILT TO SOLVE SPECIFIC DRIVE PROBLEMS

REALLY BAD OIL CONDITIONS ARE MY OBJECTIVES. I'M SUPER-7 OIL-PROOF...MADE OF SOLID NEOPRENE. GRIMY LIQUIDS DON'T BOTHER ME.
OIL
SUPER-7 STATIC-RESISTING TALKING: MY BUILT-IN CONDUCTING ELEMENT CARRIES STATIC CHARGES TO MACHINES WHERE THEY'RE GROUNDED.
HEAVY LOADS? EASY! MY STEEL CABLES ADD POWER, REDUCE STRETCH AND SLIPPAGE. I'M SUPER-7-STEEL.
90% OF ALL OIL CONDITIONS ARE A CINCH FOR ME. NEOPRENE IS MY COVER...SUPER-7 OIL-RESISTING, MY NAME.
HOT-RUNNING DRIVES ARE WHERE I SHINE. 180°F IS JUST COMFORTABLY WARM FOR SUPER-7 HEAT RESISTING. THAT'S ME.
A 1771

IT PAYS TO MAKE **ALLIS-CHALMERS** YOUR

V-BELT DRIVE HEADQUARTERS

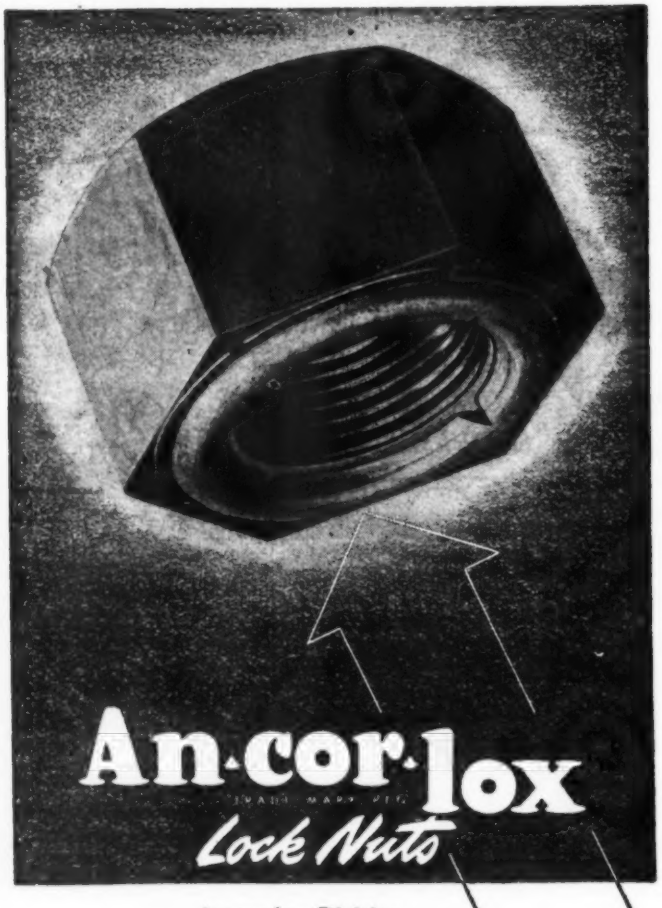
Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

Pick your own!

THE ALL-METALLIC construction of the one-unit, self-contained An-cor-lox lock nut (patented) is standard in varied types to suit individual service requirements . . . for lock nut strength, resistance to corrosion, or high working temperatures, etc. Our engineers will gladly make recommendations.

¶ *Note:* Bolt stretch, wear, or any loosening of bolt assembly, does not affect the locking grip of An-cor-lox. Our An-cor-lox bulletin tells all about it. Of interest to every production executive! Write for your copy—and An-cor-lox sample.

1878

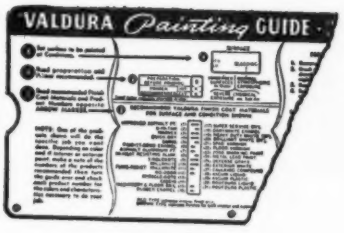


An-cor-lox Division
LAMINATED SHIM COMPANY
Incorporated
61 Union Street • Glenbrook, Conn.

dication is independent of direction of shaft rotation. Pickup windings are stationary and there are no commutators or slip rings. *Reliance Electric & Engrg Co, Cleveland, Ohio*

Chromium Plating

CHROMIUM MAY NOW be deposited electrolytically onto aluminum or aluminum alloys by the *Preplating Process.* Chromium deposits of considerable thickness can go directly onto aluminum surfaces, or follow copper, nickel, zinc or cadmium plating. Procedure for hard or decorative chromium finishes is the same as when plating on other metals, with exception that aluminum requires special surface preparation. After aluminum is thoroughly cleaned as prescribed, it is passivated, immersed in *Preplating Solution* for a few seconds, and then electroplated in usual manner with regular equipment. *Technical Processes Div, Colonial Alloys Co, Philadelphia, Pa.*



Paint Guide

HANDY METHOD selects best paint for a given application without necessity of detailed technical knowledge of different finishes. Guide makes available all information on properties of and application data necessary to choose properly from entire *Valdura* line of heavy-duty maintenance paints. Of convenient pocket size, it works on principle of a slide rule. With only two settings, it gives correct surface preparation, proper priming and finishing coats. Resistance of recommended material to heat, acid, alkali, moisture, abrasion, sun and oil is given, also coverage and drying-time data. Guide shows proper thinner to use as well as its correct proportion. Management and maintenance men may write direct for free copy. *American-Marietta Co, 43 E Ohio St, Chicago, Ill.*

Electrical Repair Kit

FOR SOLDERLESS WIRING, new electrical repair kit comes complete with tool and solderless A-MP terminals for stranded wire sizes 22 to 10. A-MP terminals are all-copper for maximum current capacity. Terminals are engineered to assure minimum voltage drop between terminal and wire, according to maker, and are constructed so that they permit easy visual inspection.

Special A-MP tool allows for cutting the wire to any desired length, has a gage to determine length of insulation to remove, and permits the wire to be inserted in an opening with markings which correspond to wire size for accurate stripping of insulation. The wire, stripped correctly by this all-purpose tool, may then have correct-

NO OTHER DRIVE BABIES THE BELT

The Flat Leather Automatic Tension drive is so easy on the belt . . . that a G&K "Research" Leather Belt will outlive a rubber V-belt on a corresponding drive . . . better than 2 to 1.

Tension is a prime factor in belt wear. Normally if tension is too high, the belt breaks down. If tension is too low, abrasion and heat, caused by slippage, wear it out. But on a F.L.A.T. drive, the pivoted base regulates tension automatically — high only when the load is heavy, low when the load is light.

The thinner cross-section of the flat leather belt minimizes belt wear caused by internal heat originating from continual flexing around pulleys on short centers.

In the infrequent cases when a flat leather belt does need replacement, the new belt can be made endless on the drive, there's no tension adjustment, no pulley alignment problem. Ask your G&K distributor for a demonstration.

Due to the properties of its exclusive tannage and curry, "Research" Leather Belting not only gives you maximum belt service, but also improves in load-carrying capacity during its entire life.

- Pre-stretching according to hide characteristics eliminates non-elastic stretch.
- Exclusive "weight-controlled" curry gives maximum pulley grip — meaning it can run with less tension (which wears belts and bearings).
- Patented "tension-cementing" gives positive ply adhesion strength.

Write Graton & Knight Company, 333, Franklin Street, Worcester 4, Massachusetts, for new, free Belting Manual.

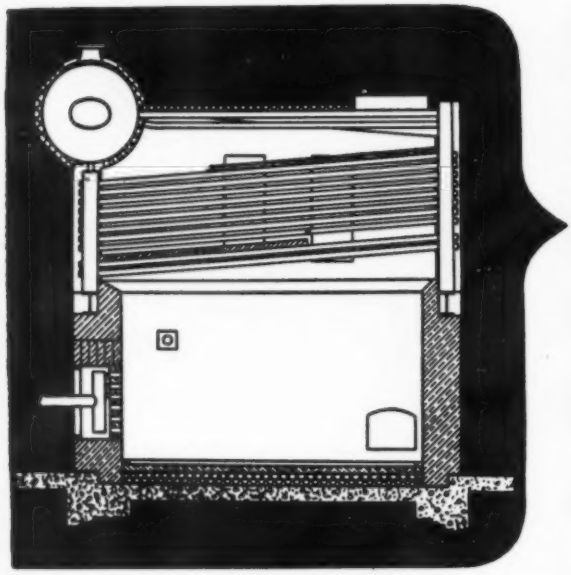
GRATON AND KNIGHT

Research Leather Belting

from Graton & Knight's complete line . . . manufactured under one control from green hide to finished product. Branches and distributors everywhere. Look under "Graton & Knight" in "Belting" section of Classified Telephone Directory or THOMAS' REGISTER.

UNION

FILE THESE UNION ADS FOR REFERENCE



H-TYPE
A-TYPE
HEATING
RADIANT TYPE
4-DRUM
O-TYPE
LONG DRUM
CROSS-DRUM
UNIVERSAL STEEL-CASED
UNIVERSAL BRICK-SETTING
HORIZONTAL RETURN TUBE
LITTLE GIANT
L-TYPE

UNION HEATING BOILER

Union, a power boiler builder designs a heating boiler that is shipped knocked down for easy installation in any existing building. It's a cross drum water tube boiler adapted to heating requirements. It brings power boiler efficiencies to heating demands. All water is preheated in the side wall headers before entering the boiler proper. As compared with any fire tube heating boiler, the Union Water Tube Heating Boiler offers greater furnace volume, better efficiency and greater capacity. ***Write for booklet today.***

UNION IRON WORKS • ERIE, PA.

BOILERS

PRESSURE VESSELS • PLATE FABRICATION

sized terminal placed in position for crimping by tool. This latter operation is by simple hand pressure and insures even, close contact at all points. *Aircraft-Marine Products Inc, Harrisburg, Pa.*

Portable Electric Drills

SIDE-HANDLE THOR DRILLS are identical in construction to original *Armored in Plastic* pistol-grip machines, except for side handle. Gear case, field case and handle are molded in specially developed *Thorite* plastic, which is said to surpass performances of heavier metal housings for durability and cool, easy handling on heavy production and maintenance jobs. All internal operating parts are supported in a metal frame entirely separate from plastic housings. Drills are available in 2500, 3750 and 5000 rpm. *Independent Pneumatic Tool Co, 600 W Jackson Blvd, Chicago 6, Ill.*

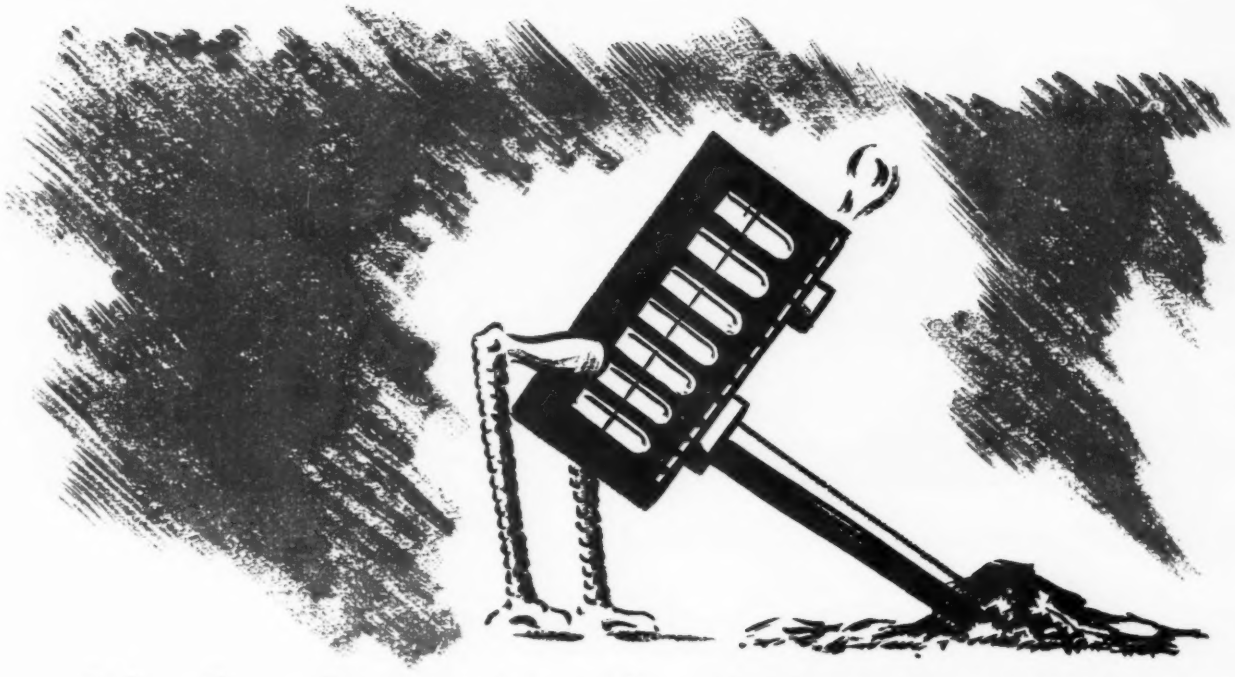
Miniature Meter

HERMETICALLY SEALED ring-mounted DeJur Model 120 meter is ideally suited to equipment which must sustain immersion. Case, including terminal studs, is completely waterproof; thus, if the glass breaks the equipment remains waterproof.

Instrument flange may be mounted on any thickness panel between $\frac{1}{16}$ and $\frac{1}{4}$ in., steel or bakelite. A waterproof gasket is supplied for sealing to panel. DeJur Model 120 is ring-mounted for easy installation, which eliminates need for mounting holes or screws. It is available in a wide range, including highly sensitive microammeter or microvoltmeter specifications. Meter is an ideal component for small equipment. *DeJur-Amsco Corp, Northern Blvd & 45th St, Long Island City 1, N. Y.*

Flax Packing

IN MANUFACTURE OF PALMETTO square flax packing, each strand is separately lubricated by same process used to lubricate *Palmetto* asbestos packing. Each single strand of flax roving is put through a machine that forces high-grade tallow under heat and pressure into core of each strand of flax. After flax strands are individually lubricated they are plaited to make finished packing. Since each strand is separately lubricated, it remains soft and pliable for long periods of time and finished packing



It's far better to be "FUEL-WISE"

It's going to be tough for those plants which are unwilling to face the future competitive era from a realistic viewpoint, because the fuels pattern is changing and coals from present primary sources may not be available.

If you are not certain as to the proper course to pursue in your planning for the future, just ask yourself such questions as these:

...Is my combustion equipment flexible?

...Are my stokers or pulverizers adequate to carry full boiler load with *any available* low-cost coal?

...Is my furnace amply large for full load and smokeless combustion with *all available coals*?

If you can't answer these questions or if you must say, "No," then it's time to be "Fuel-Wise" and consult Fairmont Coal Bureau engineers. Now is the time to think ahead and be ready *before* it's too late.

Valuable data pertaining to coal and its relation to plant operating costs are available in "Coal Reference Bulletins" which will be sent promptly on request. Ask to be placed on our mailing list. Fill out and mail coupon today.

FAIRMONT COAL BUREAU

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LOW FUSION FAIRMONT COAL IS THE COAL FOR THE "FUEL - WISE".

. . . it can be economically burned in any equipment properly engineered for its use.

. . . its huge reserves assure its availability for many years to come.

. . . it assures the lowest overall steam cost for the plant that is engineered for its use.

. . . it effects saving in coal dollars that quickly pay for the changes necessary to burn it efficiently and economically.

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MAIL COUPON TODAY

Kindly place me on your mailing list to receive copies of "Coal Reference Bulletins". It is understood these will be sent me FREE and without obligation.

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Manpower GONE—

need help on Ash Removal?

• Get the help you need by installing the fully pneumatic Beaumont "Vac-Veyor" ash handling system. Conveys ashes, clinkers, soot from pits, chambers and stack to storage silo with minimum of power and labor. No dust. No "wetting" of materials. Continuous operation. Installation as simple as running a pipe line. Low first cost. Low operating cost. Minimum critical materials required. For details—write:

BEAUMONT BIRCH COMPANY

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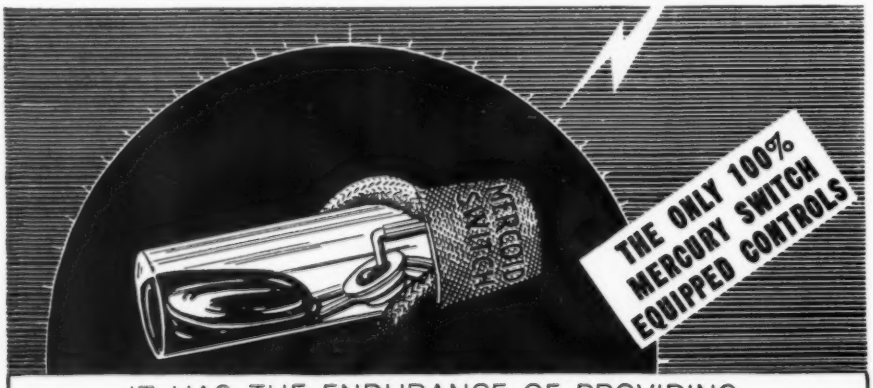
DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS



IT HAS THE ENDURANCE OF PROVIDING

MILLIONS

OF "MAKES" AND "BREAKS" IN THE ELECTRICAL CIRCUIT

The mission of a Mercoid Mercury Switch in an automatic control is to assure longer life and greater dependability—minimizing the need for attention after the control is in service. Mercoid Controls lend themselves to quick installation and adjustment, all of which are invaluable contributions in a time of national crisis.

Mercoid Switches, the distinguishing feature, used exclusively in all Mercoid Controls, are especially designed types of hermetically sealed mercury switches. They are not affected by dust, dirt, moisture or corrosive gases, nor are they subject to open arcing, oxidation, pitting or sticking of contacts—common causes of trouble.

Keep these important facts in mind when selecting automatic controls.

MERCOID CONTROLS

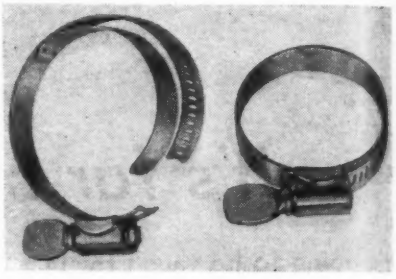
FOR HEATING, AIR CONDITIONING, REFRIGERATION, AND INDUSTRIAL APPLICATIONS

THE MERCOID CORPORATION 4205 BELMONT AVE CHICAGO 41 ILL.

resists hardening. *Palmetto* square flax packing is available in regular form or in graphited style, sometimes called waterproof hydraulic flax. *Greene, Tweed & Co, Bronx Blvd at 238th St. New York 66, New York.*

Circuit Tester

LO-VOLT TEST GLO for testing circuits from 5 to 50 v is compact so that it can be carried in the pocket. Over-all length is only 7 in. Fully insulated test leads are 4 in. long. It simplifies testing of open circuits, burned-out fuses and serves to indicate relative value of line voltage. The incandescent *glow* lamp is protected by a transparent plastic housing. *Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.*



Hose Clamp

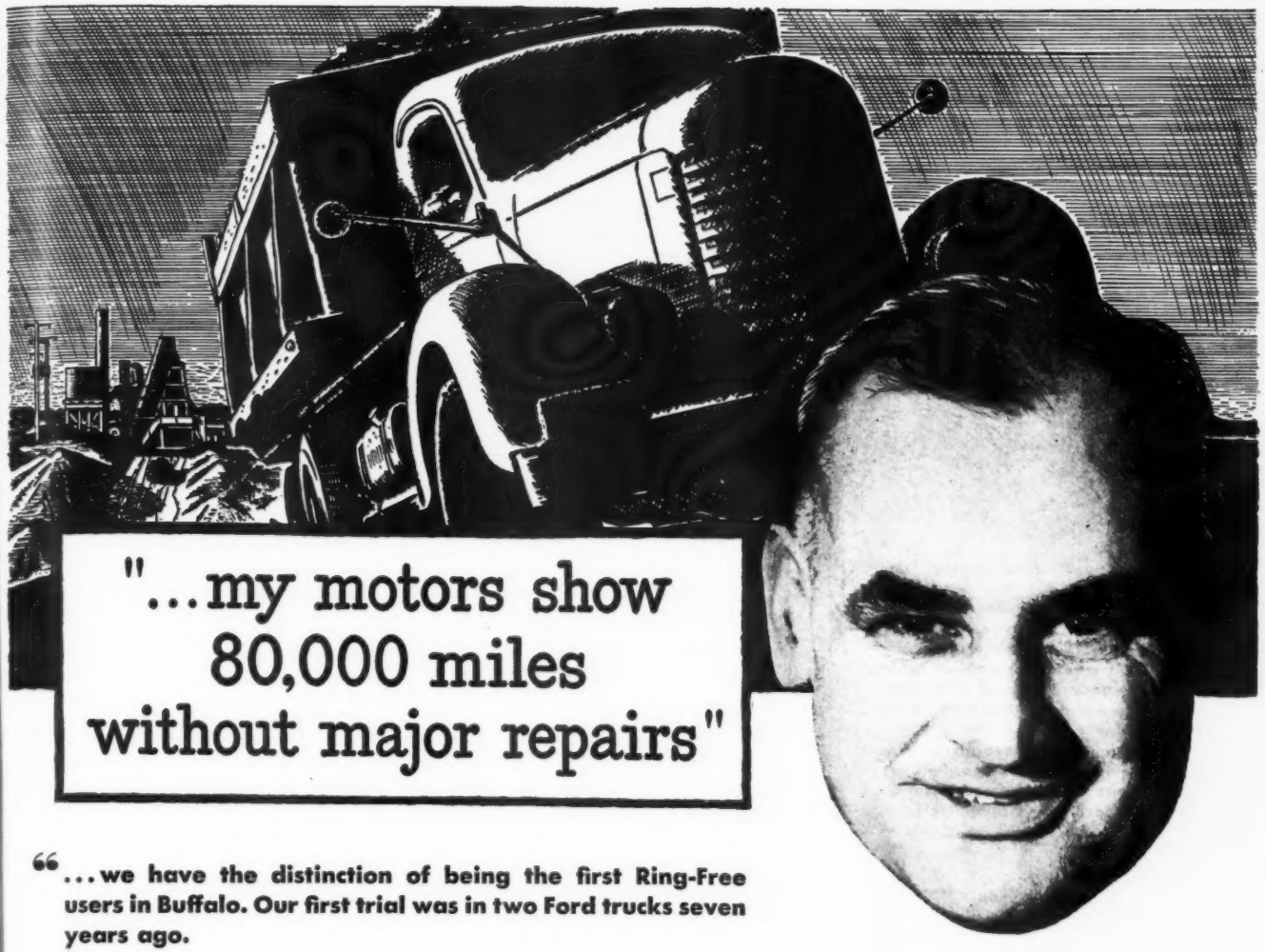
WITTEK WWD WORM-DRIVE hose clamp, made to specification AN-FF-C-406A, incorporates an inner band of stainless steel which protects hose from serrations in outer band and distributes load uniformly to provide greater strength and superior sealing characteristics. Clamp is available in eight adjustable sizes to cover entire range of applications. *Wittek Mfg Co, Chicago 23, Ill.*

Pressure Blowers

INCREASED EFFICIENCY and economy are said to be outstanding characteristics of two new lines of pressure blowers. Unit designated as Type CB (centrifugal blower) has a capacity range from 200 to 5000 cu ft per min and a pressure range from ¾ to 2 psi. Type CC (centrifugal compressor) unit ranges in capacity from 4000 to 75,000 cfm, at pressures up to 4 psi. *Buffalo Forge Co, Buffalo, N. Y.*

Flow Tube

GENTILE FLOW TUBE is a new primary element for metering fluids that uses the average velocity immediately adjacent to the wall of a pipe, or conduit, as a criterion of flow. It consists simply of a short length of pipe on the inner periphery of which are mounted two groups of pressure nozzles, one group pointing upstream and the other downstream. Nozzle groups are interconnected by common pressure rings, from which connections are made to high- and low-pressure sides of a recording and integrating meter. *Coldwell-Wilcox Div, Krajewski-Pesant Mfg Corp, 227 Fulton St, New York, N. Y.*



"...my motors show 80,000 miles without major repairs"

"...we have the distinction of being the first Ring-Free users in Buffalo. Our first trial was in two Ford trucks seven years ago.

...our fleet has increased to fourteen trucks including Autocars, Internationals, Fords and one Chevrolet.

...trucks are all used in hauling sand and gravel...the hardest kind of work on trucks as roads are bad...loads are heavy. Due to conditions there is a constant uneven strain on motor bearings.

...if Ring-Free did not have a tough film strength that protected these bearings my motors would not be able to show 80,000 miles without major repairs as many of them have.

...Ring-Free's ability to penetrate even to the top of the pistons and keep the upper rings free gives my motors all the power they were intended to have.

...my first International truck went 110,000 miles with only $50 repairs...proper lubrication was responsible."

Excerpts from letter of—

George Muehlbauer

George Muehlbauer
205 Courtland Avenue
Buffalo, New York

MACMILLAN RING-FREE MOTOR OIL

Operators of all types of equipment report lower-cost, more efficient performance with Ring-Free Motor Oil. Find out how Ring-Free can help lick your toughest lubrication problems. ...Phone or write the nearest Macmillan office.

MACMILLAN PETROLEUM CORPORATION

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LUBRIPLATE No. 105

This very smooth, light density (semi-fluid) grease type lubricant resists water and other unfavorable operating conditions to a marked degree. LUBRIPLATE No. 105 not only provides superior lubrication but offers utmost protection against rust and corrosion. Because of its water-proof feature and freedom from "drag", it is ideal for

General Industry	Firearms
Radio Equipment	Outboard Motors
Instruments	Home Appliances
Business Machines	Fishing Reels

LUBRIPLATE

Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE

Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE

Lubricants are extremely economical, for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

Write for a booklet, "The LUBRIPLATE Film", written especially for your industry.

LUBRIPLATE

FISKE BROTHERS REFINING CO.

NEWARK 5, N. J.
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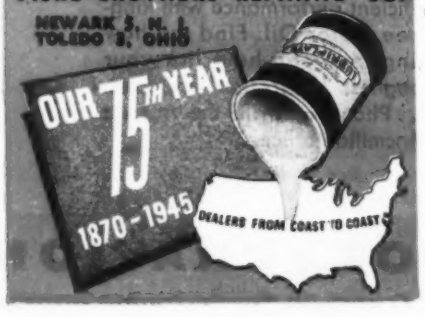

Power News

(*Continued from page* 130)

The SFAW spokesman said that if war production were cut back 40 to 50%, the coal crisis would vanish under impact of reduced demands and increased manpower. If the cutbacks are limited to about 20%, there may be trouble. Only hope for bituminous coal production over and above the anticipated 575,000,000 tons for the current coal year, he said, lies in heavy industrial cutbacks which would free workers for mining, along with military discharges making more miners available.

Junking of the brownout probably would embarrass OWU with regard to maintenance of *war time*, a strenuous drive against which is anticipated after V-E Day. The brownout was instituted, so far as OWU was concerned, as a coal conservation measure. The wide acceptance which the electric power industry has accorded the brownout was based on the same belief. The logical conclusion would then be that there will be no need for coal saving after V-E day.

In campaigning for continuation of war time this year, OWU has stressed coal savings as well as capacity savings. The Army and SFAW have urged the coal savings as well. If the brownout be repealed on V-E day, it is believed the argument of coal savings will no longer be effective in urging the continuation of war time, regardless of its validity.

If war time and brownout both are dropped after V-E Day, electric utility loads may not show even the moderate decline now anticipated after V-E Day, and in some regions, the capacity situation will be close. Regardless of what happens, OWU plans to enforce the brownout as usual until V-E Day.

Oil & Gas Power Div of American Society of Mechanical Engineers announces that the 1945 meeting will not be held as scheduled because of government restrictions at present applying to holding of meetings. The meeting for 1946 will be held in Milwaukee and many plans for the now deferred event will be carried through to next year.

Power-pool elevation at the new Norfolk dam in Arkansas reached 552.6 ft recently and discharge at rate of 5000 cfs has begun through the big spillways. Everything above 552 ft is considered flood control, according to Roy House, resident engineer. The lake was not expected to be filled before April, but reached the *top level* in mid-March as a result of the heavy rainfall throughout the Ozark region.

LUBRIPLATE No. 107

Industry, especially food packers, have long required a waterproof lubricant that was clean and easy to apply. LUBRIPLATE No. 107 is the answer. It is a general purpose lubricant, white in color and just the right density for application by pressure guns or grease cups. LUBRIPLATE No. 107, like other LUBRIPLATE products, arrests progressive wear, saves power, and protects machines against rust and corrosion. It will pay you to try LUBRIPLATE and see how it will cut down repairs.

Rx FOR YOUR MACHINERY

No. 3—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers).

No. 107—One of the most popular grease type products for general application by pressure gun or cups.

No. 70—For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

Write for a booklet, "The LUBRIPLATE Film" written especially for your industry.

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FISKE BROTHERS REFINING CO.

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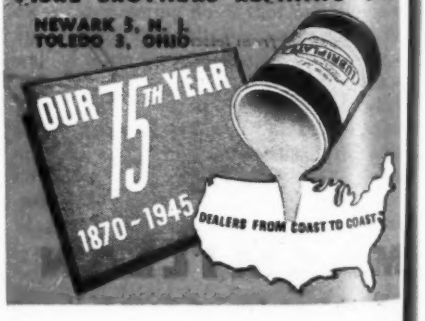
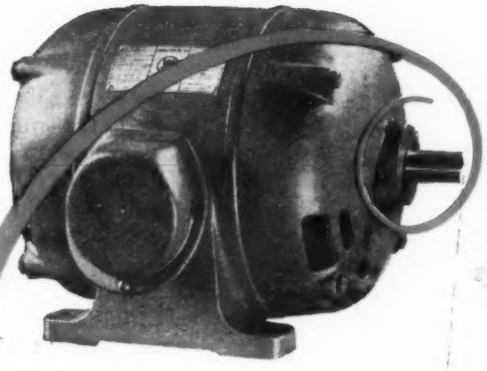


PRELUBRICATED SEALED BALL BEARINGS...NOW STANDARD ON TYPE CSP MOTORS UP TO 3 HP

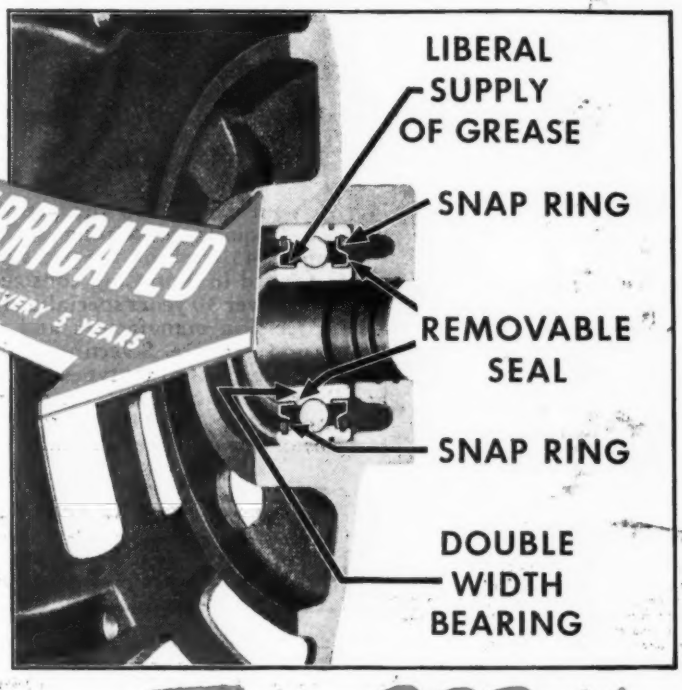


Bought now, Westinghouse Type CSP Prelubricated Motors need no greasing till 1950! Extensively field tested in thousands of textile motor applications, the prelubricated ball bearings in Westinghouse Type CSP general-purpose motors have proved they can operate five years . . . 24 hours a day . . . without greasing. Overgreasing and consequent grease seepage into windings is eliminated. One of the major items of induction motor maintenance, periodic greasing, has been reduced to one grease packing job in five years.

Every Westinghouse Type CSP Motor up to 3 hp carries the "Prelubricated" label. For complete information on how the Type CSP Motor can reduce your maintenance, write for D.B. 3100-CSP. Westinghouse Electric & Manufacturing Co., P.O. Box 868, Pittsburgh 30, Pa.

J-21317

FORGET LUBRICATION... *till 1950!*



PRELUBRICATED
CHANGE GREASE EVERY 5 YEARS

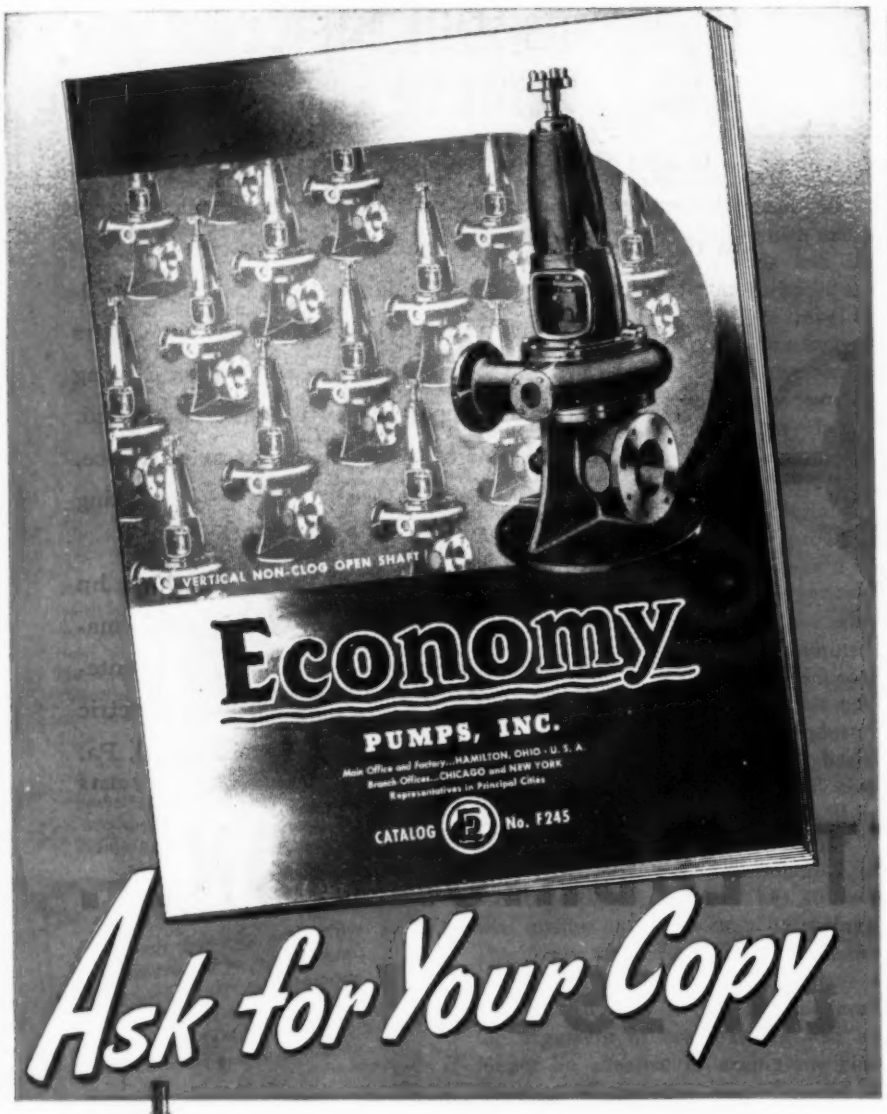
ADVANTAGES OF WESTINGHOUSE TYPE CSP PRELUBRICATED MOTORS

- **Prelubricated Sealed Ball Bearings** reduce lubrication maintenance . . . assure longer grease life
- **Improved Tuffernell Insulation**
- **Dynamically Balanced Rotor**
- **Die-cast Rotor** with oversize fan
- **Liberal Through-ventilation**—air enters front, leaves at drive end of motor

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Type CSP Motors


VERTICAL NON-CLOG OPEN SHAFT
Economy
PUMPS, INC.
Main Office and Factory—HAMILTON, OHIO · U. S. A.
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CATALOG No. F245
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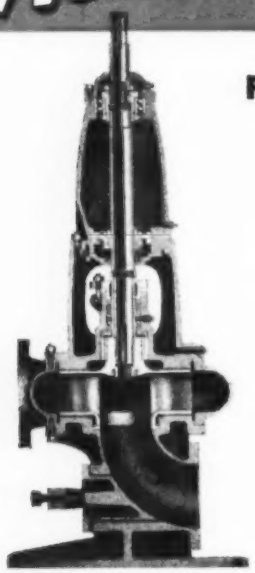

Cross Section view of Type SSV Pump showing Adjusting Nut for taking up Impeller wear, Bronze Renewable Shock Absorber and other exclusive features described in Cat. F-245.

Featuring the Newest Designs... Complete Selection Tables of VERTICAL NON-CLOG PUMPS!

Here's your answer to the problem of pumping liquids containing solids, etc. Catalog F-245 fresh off the press presents the last word in Non-Clog construction—backed by over 30 years specialized experience, precision manufacture and modern production practice. Selection tables simplify the choice of exact types and sizes to handle your requirements. A copy of the Catalog is yours for the asking. So are the services of our engineering staff.

NOTE: There still are some valuable territories not under sales contract. Write for information on sales plan and distribution of Economy Pumps.

ECONOMY PUMPS, INC.
HAMILTON, OHIO

Send Economy Cat. F-245 without obligation to:

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OWU Recommends Transfer of Generating Equipment

The first problem involving disposition of war-surplus electric-generating equipment is expected to be settled shortly by an Office of War Utilities formal recommendation to the Defense Plant Corp that it transfer to the Interior Dept a 35,000-kw steam turbine and boiler, now inactive at the federally owned magnesium plant at Lake Charles, La.

Interior has been seeking the unit for installation in Lake Catherine, Ark., generating station now operating with a federally owned aluminum plant there. The 35,000-kw machine originally was intended for Lake Catherine, where foundations and gas supply for its boiler already exist. At least one privately owned electric company has attempted to obtain control of the unit by lease with an option to purchase. The machine, about 95% completed, would cost more than $200,000 to complete and would not be in operation at Lake Catherine in less than six months.

Basis for the recommendation in favor of Interior was the existence of a power supply deficiency in Arkansas area and the fact that the Lake Charles unit can be in operation at least a year earlier than a new unit could be installed in the region otherwise. The projected transfer would require less manpower and critical materials.

OWU Authorization

The Arkansas Power & Light Co has asked OWU for authorization for a new unit of about the same size. Even if the Lake Charles unit goes to Lake Catherine, AP&L's request may be granted. Reserves in the area are now about 70,000 kw and some capacity normally considered reserve is in use.

Gulf States Power Co, receiving energy from the Lake Charles plant under a contract for 22,000 kw, has attempted to lease the unit in question. This demand is now being supplied from the output of eight 7500-kw and one 15,000-kw machine. Three of the smaller units, without boilers, are more or less firmly committed to the Dutch, who want them for pumping out inundated sections of The Netherlands. The Army has asked for five boilers to be installed elsewhere in industrial stations and Dept of Interior has asked for one 7500-kw machine for installation in an undisclosed station in Montana. It will be necessary to retain three 7500-kw units, or one 7500-kw machine and the 15,000-kw unit, at Lake Charles to fill the Gulf States contract.

MAXIM
HAS THE "KNOW-HOW"
As the pioneer Company in the development and manufacture of silencing equipment, Maxim has experience "plus" to offer in solving your silencing problems. Maxim exhaust and intake silencers, spark arrestors, steam blow-off silencers and the new Heat Recovery silencers are in operation today in industry from coast to coast. When the problem is silencing, consult Maxim.

ARMY E NAVY

MAXIM

THE MAXIM SILENCER CO. • 92 HOMESTEAD AVE., HARTFORD, CONN.

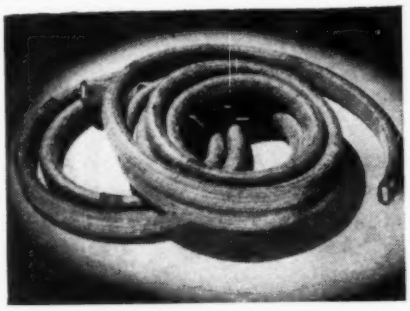
EUREKA OVAL GUM CORE

the all-round packing for general use

Except for high pressure steam, OVAL GUM CORE is recommended for all classes of service and can be depended on to give longer and better service.

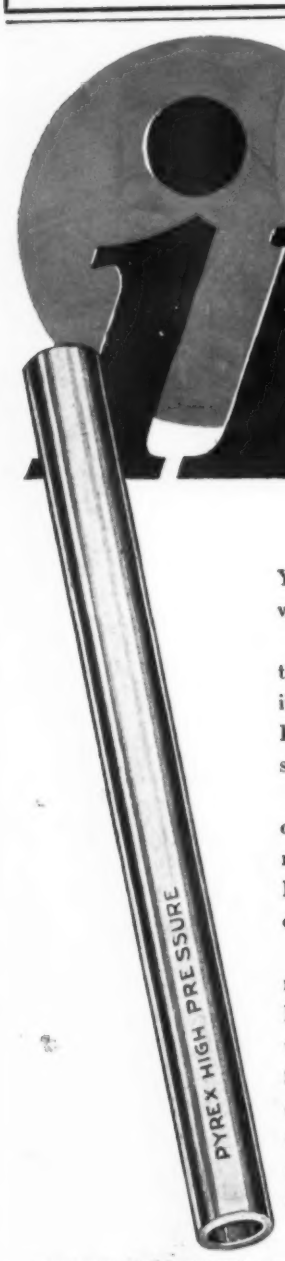
EUREKA OVAL GUM CORE is made of high quality black rubber core over which is braided imported EUREKA yarn thoroughly lubricated by a special process. Made OVAL in sizes from 3/16" to 2". A trial will prove its effectiveness and economy.

PATENTED "EUREKA" TRADE MARK



Trial sample available on request. Send for the EUREKA 36-page catalog covering complete packing line.

EUREKA PACKING CO., 294-296 46th St., Brooklyn 20, N. Y.



if your service INVOLVES EXTREME TEMPERATURE SHOCKS use PYREX HIGH PRESSURE GAUGE GLASSES

You can't blame an ordinary gauge glass for going all to pieces when you subject it to extreme and sudden changes in temperature.

For that service you need a PYREX High Pressure Gauge Glass, the kind that withstands such temperature shocks that occur when it is heated to 425°F. and then plunged immediately into ice water. PYREX Gauge Glasses not only withstand this severe test but stand up under mechanical shock and abuse as well.

Resistant to attack from steam and hot water, they retain original crystal clearness even after long service because they are made with machine drawn accuracy. Installation is easy and there is little danger of installation strains.

Where maximum visibility is also needed, use PYREX Red Line or Broad Red Line Gauge Glasses and where pressures are moderate CORNING Standard Gauge Glasses will give you economical service. In the complete CORNING and PYREX line you can choose the gauge glass to meet your particular operating needs.

A complete line to solve your particular gauge glass needs.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses BRAND

Russia Receives Twenty Mobile Unit Substations

Each unit is an entirely self-contained electric substation and includes a disconnecting switch for the incoming high-voltage line, high-voltage power fuses, lightning arresters, 3-phase power transformer and metal-clad switchgear equipment for two or three outgoing feeder circuits—all mounted on a heavy-duty 8-wheeled highway trailer. The trailers may be drawn by suitable trucks or tractors and are capable of traveling at a speed of 40 miles per hr over paved highways.

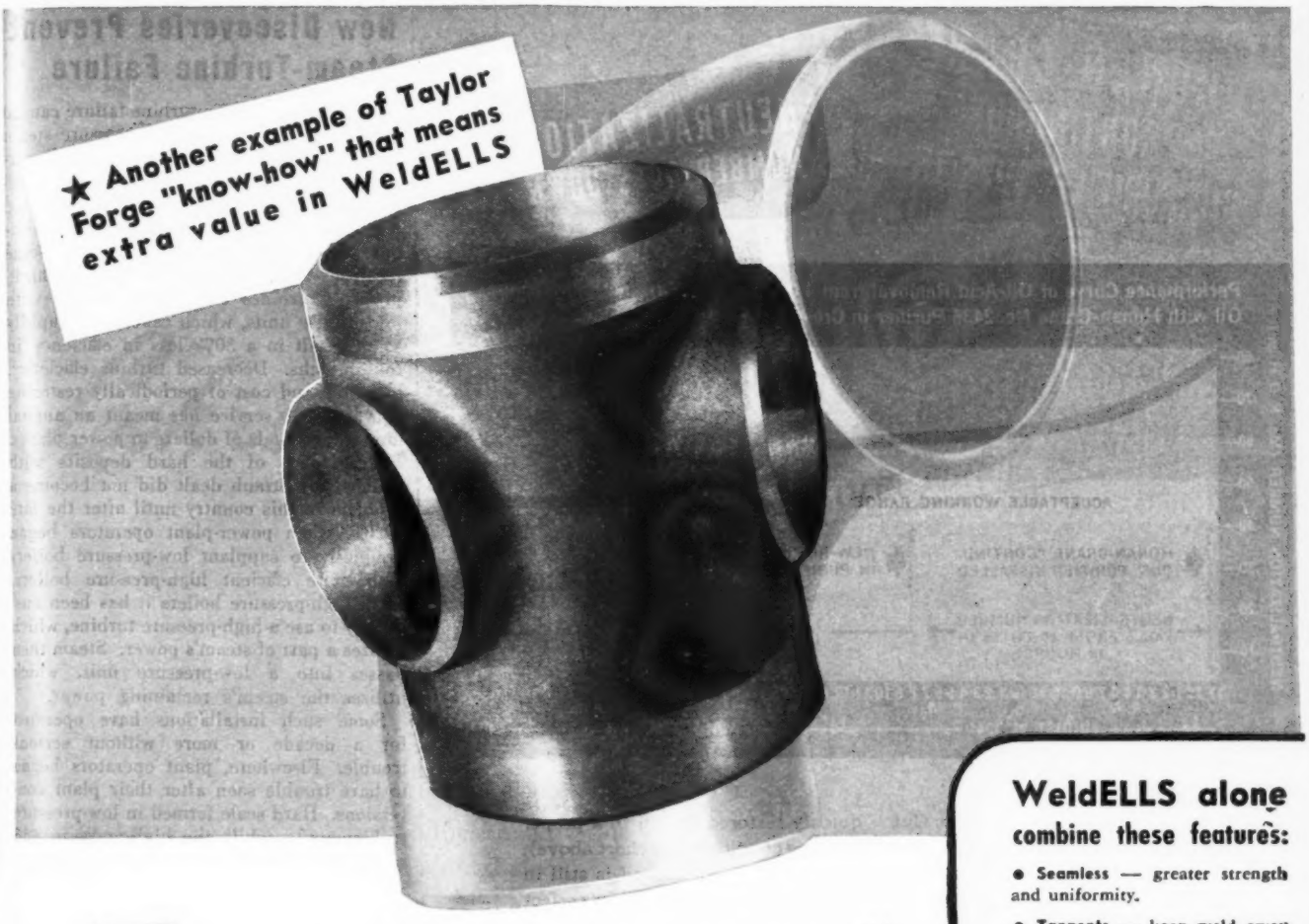
Designed and manufactured by General Electric Co to restore electric power in devastated areas and towns until local equipment can be placed in service, these 20 mobile unit substations are the first complete trailer substations to be exported for service in war-torn areas. Ten of the units are rated 1000 kva and the remainder 1800 kva.

The substations have a high-voltage rating of 35,000 v and can be used throughout Russia because this sub-transmission voltage has been standardized. Voltage may be stepped down to either 3150 or 6300 v. Each substation includes spare bushings, fuses, insulators, etc, estimated to be sufficient for one year's normal operation. These spares, together with connecting clamps, grounding rods and other operating accessories, are carried in storage compartments that are an integral part of the equipment.

Transformers are of self-cooled design with supplemental cooling fans. Operating attention has been minimized by transformer thermal relays. They automatically start the cooling fans when required, sound an alarm if transformer loading produces an abnormal temperature rise, and trip the feeder circuit breakers to remove the load and protect the transformer before an excessive temperature is reached.

Federal Power Commission has received an application filed by Fresno irrigation district for a preliminary permit for three years for a hydroelectric project on North Fork and main channel of Kings River, Calif. Development will include two dams creating reservoirs with estimated total storage capacity of 1,128,000 acre-ft, designated as Wishon and Pine Flat reservoirs, two tunnels and three powerhouses having a total installed capacity of about 183,000 hp. Energy generated by project will be for irrigation, industrial and domestic service in Kings River area and adjacent territory.

Installations to handle coal direct from cars to firing apparatus are being designed in part and installed at Avondale Mills, Sylacauga, Ala., by Rust Engineering Co, Birmingham, Ala. Equipment consists of track hopper and grating with spout to flight feeder, which feeds coal to bucket elevator, which in turn feeds to a tile silo of about 200-ton capacity. From the silo, coal is fed to an automatic scale and then spouted to pulverizers. Provision is made to spout excess coal from silo to dead storage on ground.



"First time on any stage"

★ *As far as we know this is the only welding fitting of its kind. We forged it seamless in carbon-moly—10" pipe size in the run with .605" wall, and 7" in each branch with .429" walls.*

It is neither "fish nor fowl"—not a side outlet tee because the included angle between the outlets is more than 90°, and it could hardly be called a cross. It's just one of the many once-in-a-life-time forging problems that have been assigned to us by engineers who have found that we do things with hot metal that no one else does.

YOU say you don't ever expect to run into a condition calling for a fitting like this? Probably not. But you do use standard welding fittings and this special fitting has a vital bearing on their selection. We have cited this and many other special forging problems because the "know-how" accumulated in solving them is the vital ingredient in every fitting in our regular production line of WeldELLS and other Taylor Forge fittings for pipe welding.

Every one of these many special problems has added something to our knowledge in a field where knowledge is all important. What else could explain the unduplicated combination of features found in WeldELLS . . . features like extra metal properly distributed where stresses are greatest . . . tangents . . . extremely accurate dimensions . . . and the many other features listed opposite?

What else, indeed, could have developed fittings of which it can be said:

WeldELLS have everything

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
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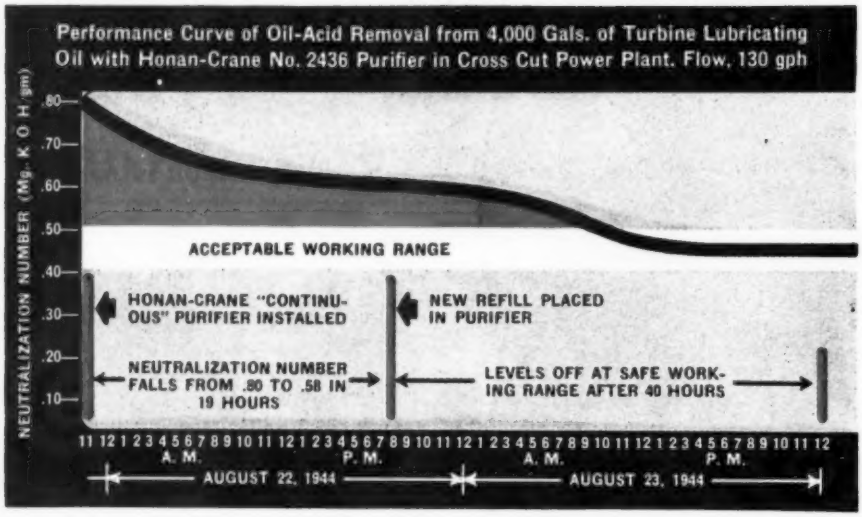
HONAN-CRANE "CONTINUOUS" OIL PURIFIER GOES IN— NEUTRALIZATION NUMBER GOES DOWN

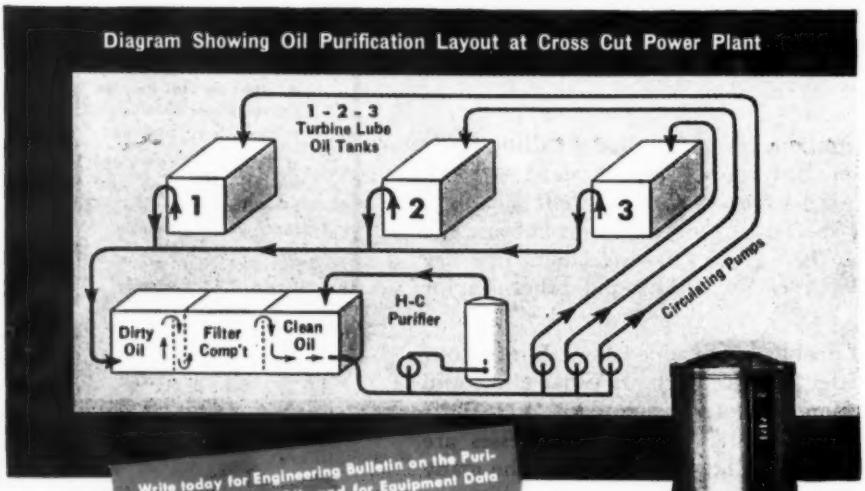

Performance Curve of Oil-Acid Removal from 4,000 Gals. of Turbine Lubricating Oil with Honan-Crane No. 2436 Purifier in Cross Cut Power Plant. Flow, 130 gph
NEUTRALIZATION NUMBER (Mg. K O H gm)
.80
.70
.60
.50
.40
.30
.20
.10
ACCEPTABLE WORKING RANGE
HONAN-CRANE "CONTINUOUS" PURIFIER INSTALLED
NEW REFILL PLACED IN PURIFIER
NEUTRALIZATION NUMBER FALLS FROM .80 TO .58 IN 19 HOURS
LEVELS OFF AT SAFE WORKING RANGE AFTER 40 HOURS
11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
A. M.
P. M.
A. M.
P. M.
AUGUST 22, 1944
AUGUST 23, 1944

● In August, 1944, in the Cross Cut Power Plant, Tempe, Arizona, the neutralization number of the 4,000 gallons of Turbine Oil in service suddenly jumped to unsafe limits with resultant sludging.

The cause was found and corrected, but the damage had already been done to the oil. To replace the oil would have cost $3,000.

On August 22 a Number 2436 Honan-Crane Purifier was added to the oil purification system and quickly restored the oil to a proper working condition (see chart above), at a cost of $75. The oil is still in service and is maintained in perfect condition at a cost of $50 per year. These facts are taken from a report prepared by Clyde Williams, superintendent.

Honan-Crane "Continuous" Oil Purifiers furnish safe protection for any turbine by removing all abrasives as well as acids and other soluble contamination.



Write today for Engineering Bulletin on the Purification of Turbine Oils and for Equipment Data on Honan-Crane "Continuous" Oil Purifiers.

HONAN-CRANE CORPORATION

Subsidiary of Houdaille-Hershey Corporation

1200 Sixth St., LEBANON, IND.

New Discoveries Prevent Steam-Turbine Failure

Prevention of steam-turbine failure caused by silica deposits from high-pressure steam is made possible by discoveries at University of Illinois by F G Straub, special research professor of chemical engineering.

Hard silica deposits have become a serious problem in power plants in some localities following installation of high-pressure turbines working in tandem with low-presure units, which cake up so rapidly as to result in a 30% loss in efficiency in four months. Decreased turbine efficiency, lost time and cost of periodically restoring equipment to service has meant an annual loss of thousands of dollars to power plants.

Occurrence of the hard deposits with which Prof Straub dealt did not become a problem in this country until after the late 1920's, when power-plant operators began gradually to supplant low-pressure boilers with more efficient high-pressure boilers. With high-pressure boilers it has been customary to use a high-pressure turbine, which utilizes a part of steam's power. Steam then passes into a low-pressure unit, which utilizes the steam's remaining power.

Some such installations have operated for a decade or more without serious trouble. Elsewhere, plant operators began to have trouble soon after their plant conversions. Hard scale formed in low-pressure turbine units, while the high-pressure end remained comparatively clean.

Quartz Deposits

Analysis showed the deposits to be almost pure quartz. Their source was a scientific puzzle. It was apparent that whatever caused the deposits had to enter the turbine in vapor form.

Vaporization of silicic acid, Prof Straub has found, is the cause of the deposits. Conditions of heat and pressure prevailing inside a high-pressure boiler are such as to convert silicates present in boiler water into silicic acid, which is easily volatilized or converted into vapor.

It was found, too, that at plants where such deposits do not occur rapidly enough to create a problem, the boiler water, if it contained silicates, also contained magnesium salts. Conditions within high-pressure boilers caused the silicates and magnesium salts to combine and form a sludge in the boiler. This sludge can be drawn off at bottom of boiler; the silicates therefore do not form silicic acid or consequent silicic acid vaporization.

Control of the condition resulting from formation of silicate deposits in low-pressure turbines depends to some degree upon a periodical analysis of steam used. Prof Straub, in collaboration with Hilary A Grabowski, former research assistant on University of Illinois chemical engineering staff, now serving in the Navy, developed a method for quickly analyzing high-pressure steam.

This method makes it possible to detect presence of silicates in quantities as low as one hundredth of one part per million. If analysis indicates presence of silica in sufficient quantity to cause trouble, any of several previously known methods may be used to reduce steam's silica content.

Look over this ADVANCED TYPE INFRA-RED OVEN

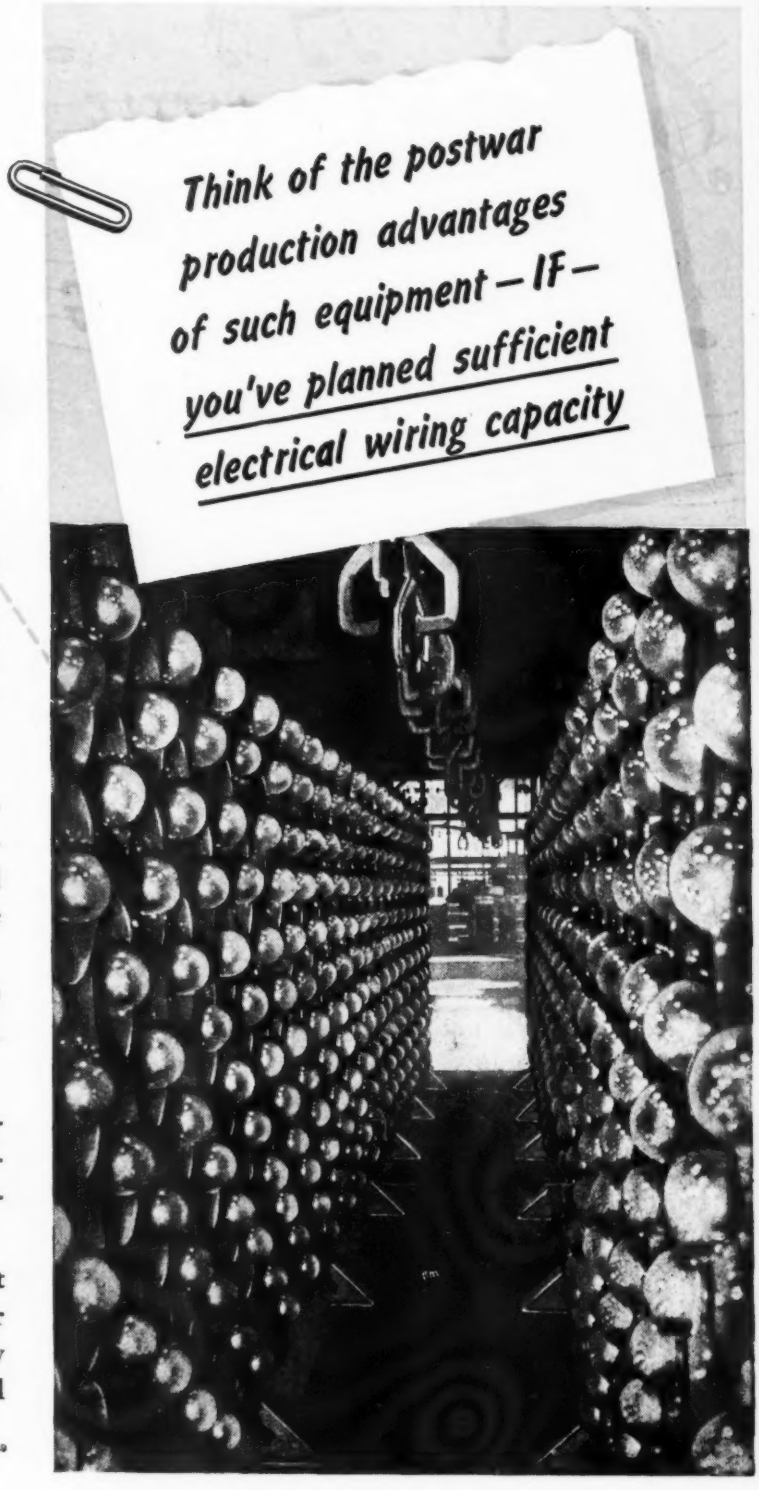
NATURALLY YOU'LL WANT the production advantages of tomorrow's new, improved electrical equipment. But so often advanced machines fail to work efficiently because plants are electrically underwired.

What about *your* postwar wiring set-up? Is it planned by *past* standards or in anticipation of *future* needs?

Don't take chances—Wire Ahead! Foresighted wiring now can save expensive alterations later—costly downtime—lost production and good will.

Today—call in your consulting or plant power engineer, electrical contractor or power salesman. They know wiring capacity must meet the coming expansion in electrical usage. They too will say—Wire Ahead!

45269


Think of the postwar production advantages of such equipment—IF—you've planned sufficient electrical wiring capacity

Fourteen banks with 36 lamps each give this improved infra-red oven tremendous drying capacity.

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GENERAL OFFICES: 25 Broadway, New York City 4 — *Subsidiary of Anaconda Copper Mining Company*

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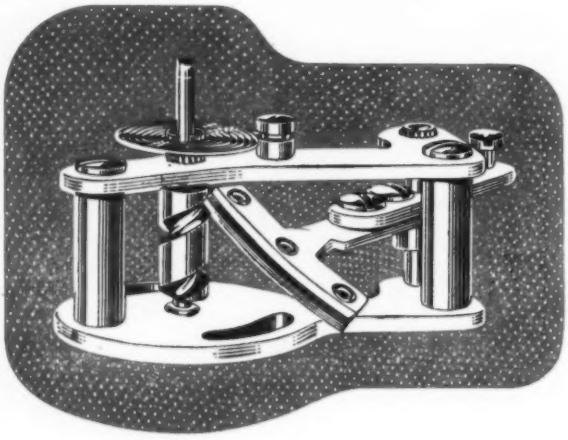
✔ *Check Your Wiring Plans Before They Check You!*

HERE'S A LITTLE MOVEMENT WITH A MEANING ALL ITS OWN



And this little movement has special significance to you as a pressure gauge user. It means longer gauge life and greater accuracy. As you can see, the Helicoid Movement has no teeth to wear or foul. The polished Bakelite cam facing simply rolls smoothly in the polished groove of the hard roller. Friction and inertia are reduced to minimum.

Only Certified Gauges have the patented Helicoid Movement.

Now, after several years use in the Navy, Certified Gauges are available to industry. Many of the largest companies in the country are already using them.

All Certified Gauges are guaranteed accurate to within ½ of 1%. They stay accurate longer. Send for catalog today.

Certified GAUGE AND INSTRUMENT CORP.

54-18 Northern Boulevard — Long Island City 1, New York

5-CG-4

Maintenance Is a Vital Industrial Operation

While war is a great waster of natural resources, it also starts creative juices working to the end that man may always have a substitute for things that are gone.* An example is the part that glass insulation has played in our production operations during the past three years. While this item was not a *war baby*, it will play a great part in the after-war conservation period. With the difficulty in obtaining that other important Class B item—asbestos—glass has really saved the day.

As an example of growth in this material's use, Westinghouse in 1938 used $38,000 worth as coil insulation. Just five years later, in 1943, we insulated our electrical machines with $960,000 worth of glass. This year, because of many additional applications it will run about $1,500,000.

Glass as an insulating medium has been with us long enough for most of the kinks to be ironed out and to provide us with data on what to expect. In the war effort its use has permitted production of motors for special purposes that could not otherwise have been made. It is this angle that is going to be of great aid in conserving materials in the postwar period. Before the war the average temperature for general industrial motors was only 26 C.

Steel mills, railways and mining locomotive fields have already taken advantage of higher permissible temperatures. On the other hand, glass insulation takes care of higher loadings with a given design of motor where, as with the railways, it has permitted greater capacity in a smaller space.

Operating Temperatures

As we tend toward higher operating temperatures, other motor parts must be taken care of as well as the coils. Where it is necessary for various reasons to operate commutator motors at temperatures higher than normal, other means than our everyday solders must be found for connecting armature leads to commutator necks. Fortunately a material has already been developed for this purpose and means for its application are available.

While these brazing materials are not new, it is only recently that some general applications to rotating machines have been made. Today practically all of our medium-sized generators have connections made with brazed joints. Armature coil leads of many dc machines are connected to commutator risers by brazing. The 5.7-kw generators on practically all bombers today are of necessity high-temperature machines with full glass insulation. Armature coil leads are connected to commutator bars by brazing.

As the brazing material melts and flows around 1300 deg., there is little to fear from open circuits at brazed joints caused by temperatures that will not ruin other machine parts. Like many other operations, a technique is required, but it is simple in character and needs no special skill.

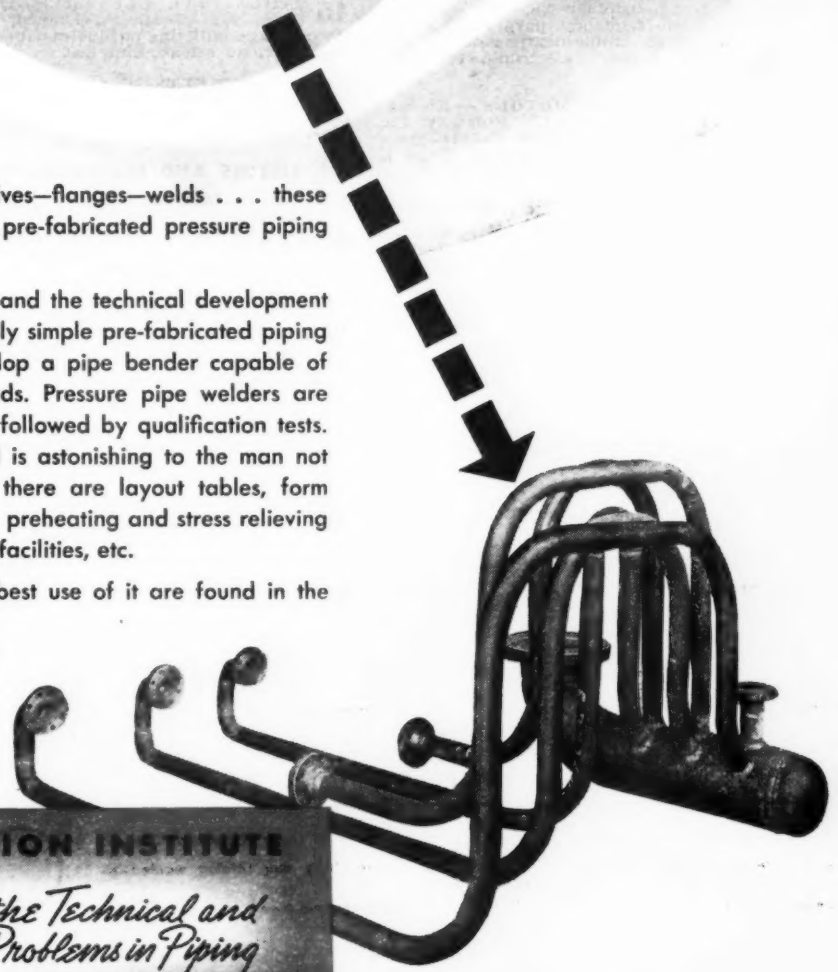
* From a talk by H B Meyer, maintenance dept, Westinghouse Electric & Mfg Co, before Electrical Maintenance Engineers of Chicago, Ill.

THERE IS MUCH MORE TO PRE-FABRICATED PRESSURE PIPING THAN MEETS THE EYE

Straight pipe—bends—laps—fittings—valves—flanges—welds . . . these are the things that meet the eye in a pre-fabricated pressure piping subassembly.

What isn't seen is the skill, experience and the technical development that went into the making of a seemingly simple pre-fabricated piping subassembly. It requires years to develop a pipe bender capable of producing consistently satisfactory bends. Pressure pipe welders are the result of long and careful training followed by qualification tests. The amount of special equipment used is astonishing to the man not familiar with pipe fabricating plants; there are layout tables, form cutting machines, work rotating fixtures, preheating and stress relieving equipment, straightening tables, testing facilities, etc.

This equipment and the skill to make best use of it are found in the shops of qualified pipe fabricators. Hence, they can save the user time and trouble and money on piping.



THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING, PITTSBURGH, PA.

6-3

These NEW Catalogs, Booklets and Bulletins Are Yours for the Asking!

CONTROLS, MECHANICAL

1 **TEMPERATURE REGULATORS** — Leslie Co, Lyndhurst, N. J. 20-page bulletin No. 404 gives construction, selection and installation of temperature regulators. Bulletin includes temperature and pressure ranges, capacity tables, specifications, dimensions and typical applications.

2 **RESISTANCE THERMOMETERS** — Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio. 12-page bulletin No. 230-A features Bailey Pyrotron electronic resistance thermometers, in indicating, recording and controlling models.

3 **PRESSURE CONTROLLERS** — Leslie Co, Lyndhurst, N. J. 12-page bulletin No. 402 discusses the Leslie control pilot which employs low-pressure air or clean, fresh water to operate a diaphragm valve in flow line of fluid to be controlled.

4 **CONTROL UNITS**—M L Bayard & Co, 1945 Indiana Ave, Philadelphia 32, Pa. 8-page manual No. A-100 describes standard related units of a new remote mechanical control system.

ELECTRICAL EQUIPMENT

5 **LOW-SPEED GENERATORS** — Electric Power Dept, Elliott Co, Ridgway, Pa. Bulletins No. PB2000E-1144 and PB2000ED-1144 explains construction features of Types E and ED low-speed ac generators.

6 **PARALLEL-PLATE CAPACITORS**—General Electric Co, Schenectady 5, N. Y. 8-page booklet No. GEA-4365 describes high-frequency parallel-plate capacitors for electronic-heater resonant circuits and other electronic-oscillator applications.

7 **SYNCHRONOUS MOTORS** — Electric Power Dept, Elliott Co, Ridgway, Pa. 4-page bulletin No. PB5000E-1144 gives construction and installation of Type E low-speed synchronous motors.

8 **ELECTRICAL UNITS**—General Electric Co, Schenectady 5, N. Y. 12-page bulletin No. GEA-4254 covers pushbutton units, selector switches and indicating lights for built-in applications.

9 **INSULATING VARNISH**—Dow Corning Corp, Box 592, Midland, Mich. 8-page booklet describes properties of DC 993 varnish and outlines procedures in applying this product to the insulation of electrical equipment.

10 **TERMINAL BLOCKS**—Dept TB, Burke Electric Co, Erie, Pa. 8-page booklet describes ten styles of Controlead terminal blocks.

MAINTENANCE MATERIALS

11 **CLEANING COMPOUND** — Oakite Products, Inc, 22 Thames St, New York 6, N. Y. 20-page digest gives tips on techniques and materials for handling cleaning, degreasing, descaling, derusting, paint stripping and other power-plant maintenance tasks.

12 **LEATHER PACKINGS** — Chicago Belting Co, Green & Washington St, Chicago 7, Ill. 64-page bulletin discusses design and application of hydraulic and pneumatic leather packings.

13 **RUST PREVENTIVES**—Sinclair Refining Co, 630 Fifth Ave, New York 20, N. Y. 4-page leaflet, "The Service Factor," First Edition, 1945, covers new rust preventives and their applications.

14 **INDUSTRIAL COATINGS** — Carbozite Corp, First National Bank Bldg, Pittsburgh 22, Pa. 16-page booklet gives instructions for applying coatings.

MECHANICAL TRANSMISSION

15 **SPEED REDUCERS** — Winfield H Smith, Inc, Springville, N. Y. 92-page catalog No. 144 explains selection, design, construction and lubrication of speed reducers.

16 **INDUSTRIAL CLUTCHES**—Hilliard Corp, 102 W 4th St, Elmira, N. Y. Two 4-page bulletins outline merits of slip and overload release clutches.

17 **CHAIN BELTS**—Chain Belt Co, Milwaukee 4, Wis. 4-page folder No. 460 discusses Rex Z-Metal chain belts and their application.

METERS AND INSTRUMENTS, MECHANICAL

18 **MECHANICAL FLOWMETER**—Builders-Providence, Inc, Providence 1, R. I. 8-page bulletin No. 318B describes construction and operation of Flo-watch.

19 **INDUSTRIAL THERMOMETERS** — Precision Thermometer & Instrument Co, 1434 Brandywine St, Philadelphia 30, Pa. 64-page bulletin E covers mercurial thermometers and related instruments.

20 **FLOWMETER** — Cochrane Corp, Philadelphia 32, Pa. 16-page bulletin No. R-100A contains helpful data on selection of a Rotameter for any particular service. Bulletin also presents catalog material on the Cochrane line.

PIPING, FITTINGS VALVES AND SPECIALTIES

21 **METAL HOSE**—Packless Metal Products Corp, New Rochelle, N. Y. 60-page manual features photographs, specifications and line drawings on installation of flexible metal hose.

22 **PRESSURE-REDUCING VALVES**—Leslie Co, Lyndhurst, N. J. 16-page bulletin No. 401-A gives selection, construction, installation and application of Leslie pressure-reducing valves. Tables on pressure ranges, capacities and dimensions are included.

23 **SELF-CLEANING STRAINERS**—Leslie Co, Lyndhurst, N. J. 4-page bulletin No. 405A describes Leslie self-cleaning strainers for steam, air, gas or liquid service.

OTHER EQUIPMENT

24 **OPEN HEATERS** — Cochrane Corp, 17th St & Allegheny Ave, Philadelphia 32, Pa. Bulletin No. 4091 shows various combinations of heaters with storage tanks and should be of interest to engineers concerned in heating water for boiler feed or process requirements.

(*Continued on page* 186)

HOW TO ORDER

Be sure to fill out, completely one coupon for each piece of literature you order. (See sample below.) This gives your request authority and helps the manufacturer to address your copy completely. Readers who fail to prepare request blanks correctly may be disappointed under difficult postal conditions and limited quantities of bulletins available today.

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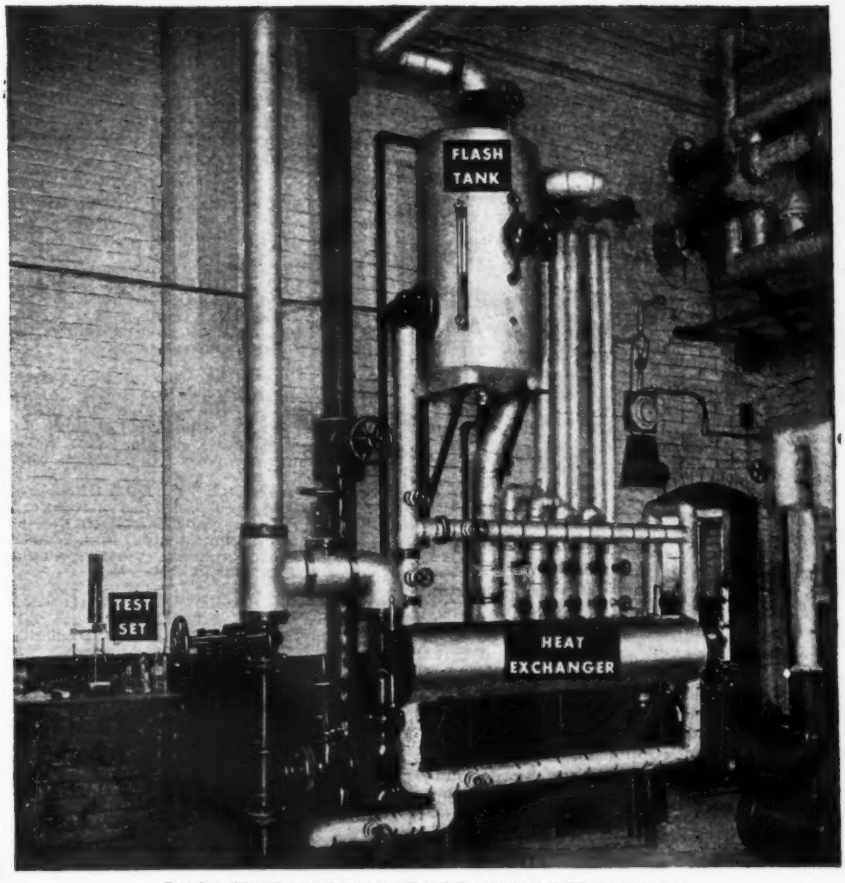
Continuous Blow-off Pays Back Original Cost More Quickly Than Almost Any Other Single Piece of Equipment

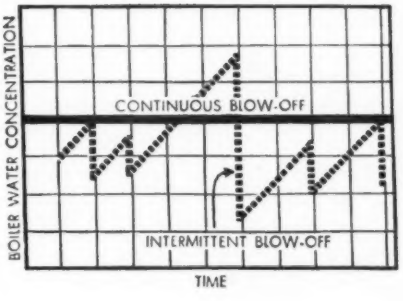


TYPICAL CONTINUOUS BLOW-OFF SYSTEM IN PLANT OF OIL REFINERY

The installation of Cochrane Continuous Blow-Off equipment recovers practically *all the heat* in the water, the only heat wasted being that which corresponds to the difference between the incoming cooling water and the blow-off water going to the Sewer.

The savings that this represents is such that in most cases the cost of the equipment can be realized in a year's time, giving a return of 100% on the investment.

As an example, an installation in the boiler plant of a large sugar company cost $1600. The first year it saved $3480, the second year it saved $3640.



MAINTAINS UNIFORM CONCENTRATIONS

With intermittent blow-down the boiler water concentration would be erratic varying from the low point to the high point between blow-downs. This is not only wasteful of heat, but may also result in foaming and priming or carry-over.

THE FLASH PRINCIPLE

Cochrane employs the flash principle in which the concentrated boiler water is flashed at a lower pressure, generating steam that can be utilized for a transfer of heat to the feedwater in the open or deaerating heater.

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Cochrane Publication No. 4081 describes many types of Continuous Blow-Off Systems, making it easy to judge the type best suited to your own requirements. Write today for a copy of this interesting study. Just drop a post card—but do it now.

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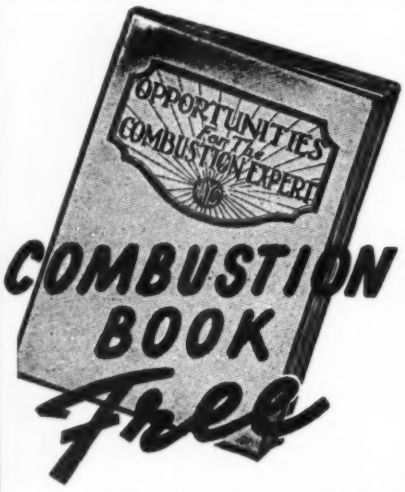
SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES



Combustion efficiency as applied to Boiler Plant Operation. Fuels and Equipment is now a most important factor in Defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.

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New Bulletins

(*Continued from page* 184)

25 FANS AND BLOWERS — Buffalo Forge Co, Buffalo 5, N. Y. Bulletins No. 3553, 3533 and 3499 discuss pressure blowers, centrifugal compressors, axial-flow fans and vent sets.

26 BOILER TUBES—Steel & Tubes Div, Republic Steel Corp, 224 E 131st St, Cleveland 8, Ohio. Card gives important information regarding care and maintenance of boiler tubes.

27 WATER HEATER AND GARBAGE BURNER—Kewanee Boiler Corp, Kewanee, Ill. 4-page catalog TW-95d describes Tabasco steel-welded hot water heater and 4-page catalog No. GW-95a features the steel-welded garbage burner.

28 DISPLACEMENT BLOWERS—Pottstown Blower Co, 431 Fayette Ave, Mamaroneck, N. Y. 16-page bulletin No. P100 explains operation, design and construction of Pottstown rotary positive displacement blowers and exhausters.

29 LOAD RATIO CONTROL — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 12-page bulletin No. B6174 presents a voltage regulator for use on power transformers to change taps without interrupting the load and to keep line voltage at proper level.

30 TUBE CLEANING—Thomas C Wilson, Inc, 21-11 44th Ave, Long Island City 1, N. Y. 16-page bulletin No. 75 outlines correct steps to be taken before, during and after a tube-cleaning operation.

31 CUTTING TOOL—William-Leonard & Associates, 801 Caxton Bldg, Cleveland 15, Ohio. 4-page folder discusses the Zim cutter No. 2, which cuts any pliable material up to 1½ in. in width.

32 COAL CRUSHERS—Jeffrey Mfg Co, Columbus 16, Ohio. 40-page catalog No. 784 covers complete line of crushing equipment. Catalog gives types, sizes, capacities, etc.

33 COAL AND ASH HANDLING MACHINERY—Jeffrey Mfg Co, Columbus 16, Ohio. 60-page catalog 778 describes various Jeffrey coal and ash handling units. Photographs, diagrams and tables are included.

34 TEST INSTRUMENTS—Weston Electrical Instrument Corp, 617 Frelinghuysen Ave, Newark 5, N. J. 8-page folder discusses Weston multirange, multipurpose test instruments, from simple 2- or 3-range instruments up to portable designs containing as many as 33 ranges.

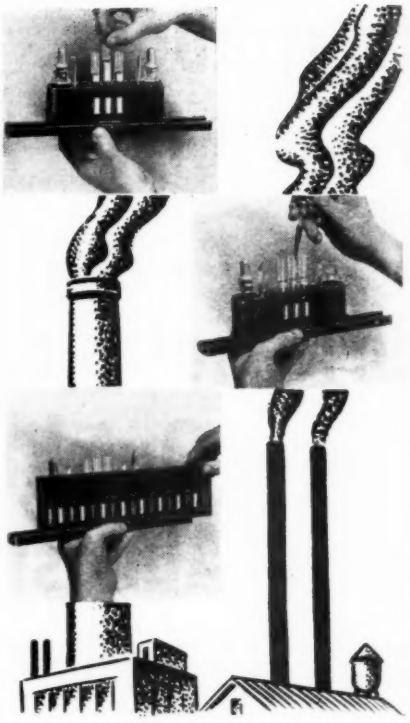
35 ELECTRIC TIMERS—Industrial Div, C H Stoelting Co, 424-P N Homan Ave, Chicago 24, Ill. 4-page bulletin No. 1100 presents table model stop clocks, wall model stop clocks, precision chronoscopes, combination timers and impulse counters, stop water controllers and spring-wound X-ray timers.

36 PLANNING GUIDE — Westinghouse Electric & Mfg Co, P O Box 868, Pittsburgh 30, Pa. 40-page booklet No. B-3153 gives planning information on 10,000- to 60,000-kw condensing turbines, surface condensers and auxiliaries for building a new plant or adding generator capacity to an existing one.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **CENTRIFUGAL PUMPS** — Economy Pumps, Inc, Hamilton, Ohio. 20-page catalog No. A145 describes single-stage double-suction pumps of large and small capacities for moderate heads. Catalog sent only to plant executives.

37 BILGE PUMP—Yeomans Bros Co, 1433 N Dayton St, Chicago 22, Ill. 20-page bulletin No. 3003 presents Yeomans' improved bilge pump design.



Don't Risk Production Slow-ups Caused by Boiler Shut-downs!

...TAKE THESE

3 EASY STEPS

TO

ACCURATE, SPEEDY DETERMINATIONS

OF

pH IN 60 SECONDS., PHOSPHATE in 2 MINUTES

WITH

TAYLOR COMPARATORS

Accuracy is assured for ALL TAYLOR Liquid Color Standards carry an UNLIMITED GUARANTEE AGAINST FADING.

FREE "SHOW HOW" BOOKLET. Tells how to prevent damage to costly equipment caused by scale, corrosion and embrittlement, thereby protecting boiler efficiency. Gives the full story of the "Why and How" of pH, Chlorine and Phosphate Control as well as complete description of all Taylor Comparators.

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Here's a Double-Duty Castable

that will save you money

Because KAST-O-LITE combines insulating properties with castable advantages—it provides monolithic linings or special shapes that cut fuel bills, reduce heat losses, and increase operating efficiency.

KAST-O-LITE is a castable refractory concrete with insulating properties and suitable for service at high temperatures in furnaces and other industrial heating units. It combines the advantages of light weight monolithic construction, low heat conductivity and high working temperature.

Now, you can have insulating furnace linings from a single package — double duty, easy-to-install castable.

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A.P. GREEN *the First Name in Refractories*
MEXICO, MISSOURI

the most AMAZING Castable Refractory in Engineering History!

QUICK DELIVERY—LOCAL STOCKS
Warehouse stocks of KAST-O-LITE are located near you for prompt delivery.

NEW! Nothing Like Kast-O-Lite

INSULATION FOR USE TO 2500° F. IN DIRECT CONTACT WITH FLAME

There is no other insulating castable like KAST-O-LITE. It's INSULATION plus CASTABLE for use in direct contact with flame to 2500° F. **DON'T CONFUSE THIS NEW ACHIEVEMENT IN CASTABLE INSULATING REFRACTORIES WITH GENERALLY OBTAINED CASTABLES FOR USE TO ONLY 1800° TO 2200° F.** KAST-O-LITE has a fireclay base—a high P.C.E—and like no other insulating castable, will withstand continued direct exposure to furnace gases at temperatures to 2500° F.

In All Types of Plants . . .

Plant men everywhere in all types of plants are praising the merits of KAST-O-LITE. R. B. Seger, General Superintendent of Lindberg Steel Treating Company of Chicago, said: "We have been using KAST-O-LITE for a long time to replace both heavy and light weight firebrick. Because this material combines both insulation and refractory qualities together with ease of installation, we find it is saving us money and doing an improved job."

FREE Data Book

A big 24-page factual book has just been prepared to tell you what KAST-O-LITE is, where it produces savings, and why it's the world's most amazing castable refractory. Mail the coupon below today for your free copy.

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Please send me your helpful new book "A Guide to the Uses & Advantages of Insulating Refractory Castable."

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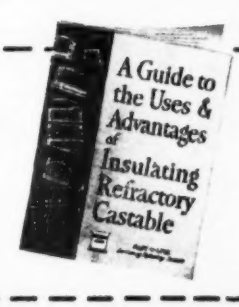
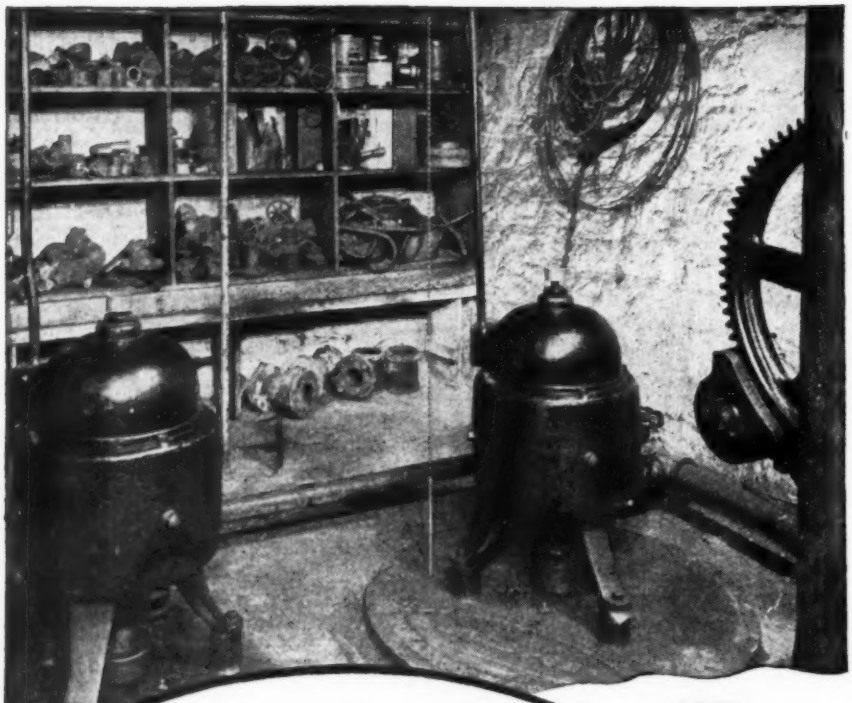


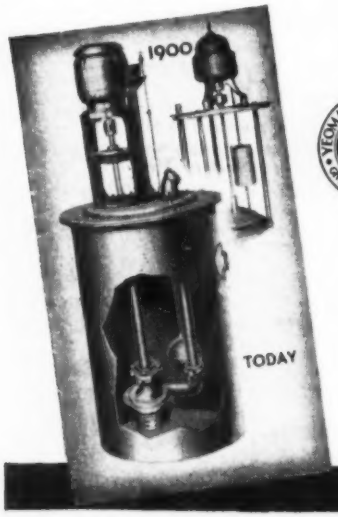


Hello, Yeomans—
does your guarantee cover pumps installed in 1902?

THIS call from Paul Zimmerman, chief engineer of Wilson Brothers Company building, Chicago, concerned one of two Yeomans centrifugal wet pit ejectors installed in 1902. For 42 years they had been tending quietly and efficiently to their job of pumping drainage, seepage and toilet wastes. Rust finally ate through the suspension pipe of one pump and attacked the impeller. A new ejector was installed.

Such records are not uncommon for Yeomans Pumps—are, rather, the usual thing. Yeomans Pumps are engineered and built to deliver just such service. This dependability you can take for granted is characteristic of all Yeomans products.

New . . . **IMPORTANT FOR YOUR DATA FILE:**
Bulletin 3003 gives full details on the new submerged pump design developed by Yeomans, pioneer builder of sewage and drainage pumps.



YEOMANS PUMPS ONE YEOMAN SERVICE

Yeomans Pumps

YEOMANS BROTHERS COMPANY
1446 North Dayton Street, Chicago 22, Illinois

38 BOILER FEEDWATER — Cochrane Corp, 17th St & Allegheny Ave, Philadelphia 32, Pa. 4-page reprint No. 39 discusses removal of ammonia from boiler feedwater.

39 WELDING—Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 32-page booklet No. W-2 describes various methods of welding with Ampco-Trode electrodes. 8-page bulletin No. W-3 covers five standard models of Ampco-Trode aluminum bronze weldrod.

40 WELDING ALLOYS—Dept A-1, Eutectic Welding Alloys Co, 40 Worth St, New York 13, N. Y. 4-page folder gives applications, uses and specifications on design and procedure of various low-temperature welding rods.

41 STEEL GRATING—Walter Bates Co, 1707 Rowell Ave, Joliet, Ill. Catalog suggests ideas for improved design and construction of open-steel flooring and stair treads.

IN CANADA

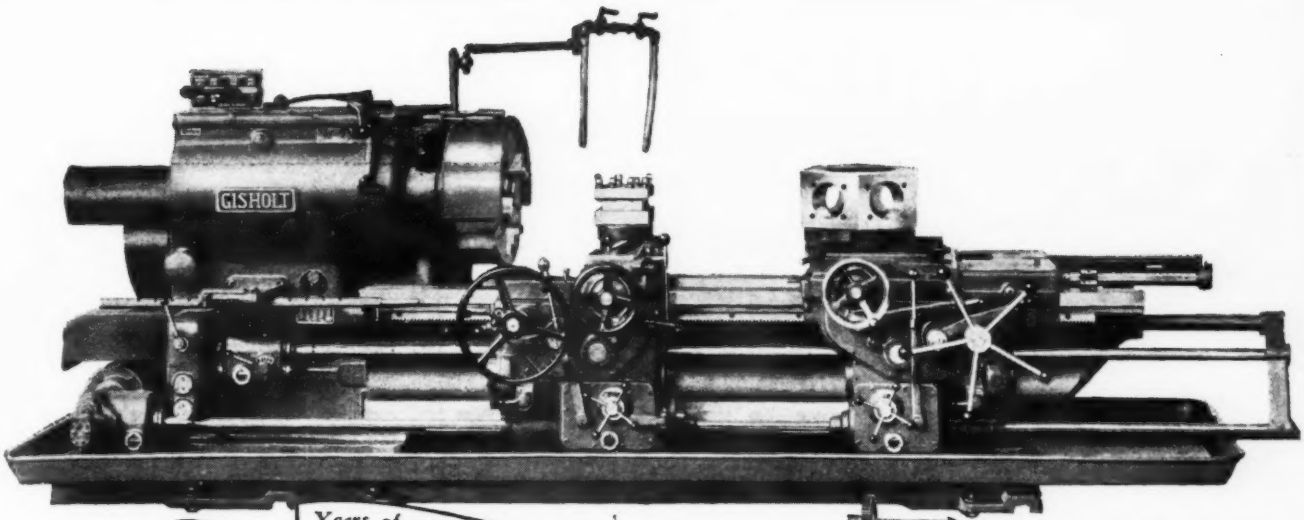
Saskatchewan government completed negotiations for purchase of entire controlling stock of Dominion Electric Power Ltd, of Estevan, Saskatchewan, at a cost of about $450,000. Ultimate objective is to have the power commission operating a province-wide system of power distribution.

Erection of a new substation by West Canadian Hydro-Electric Corp, Vernon, B. C., at a cost of $40,000 will raise capacity from 1500 to 3700 kva. Work will be started as soon as necessary priorities are secured and will be completed by July 1.

Northern Ontario Power Co has been sold to Hydro-Electric Power Comm of Ontario for $12,500,000. Northern Ontario is a subsidiary of Canada Northern Power Corp, which also owns Northern Quebec Power Co. Sale includes all assets of Northern Ontario, comprising eight hydroelectric plants, Hound Chutes compressed air power plant, 739 miles of transmission lines, 157 miles of distribution lines and 421 miles of telephone lines. Communities served include Cobalt, Haileybury, New Liskeard, Englehart, Timmins, Thornlee and mining camps in Porcupine, South Porcupine, Cobalt and Kirkland Lake districts.

Dominion Water and Power Bureau, Dept of Mines and Resources of Canada, has issued its annual review of hydroelectric progress in the dominion. This review, bulletin No. 2145, indicates that wartime expansion program in hydroelectric facilities has been virtually completed and that power production for war purposes appears to have passed its peak. Copies of review may be obtained free of charge on application to Controller, Dominion Water and Power Bureau, Dept of Mines and Resources, Ottawa, Canada.

A Peebles was elected chairman of Vancouver, B. C., branch Engineering Institute of Canada, at annual meeting at Hotel Vancouver, Vancouver, B. C. Others elected were: R C Pybus, vice-chairman; J G D'Aoust, secretary-treasurer; P B Stroyan, news editor; G W Allan, J P Fraser, N D Lambert, executive committee (2-yr. term) and J M Rothwell (1-yr term), F H Ballou and J A James.

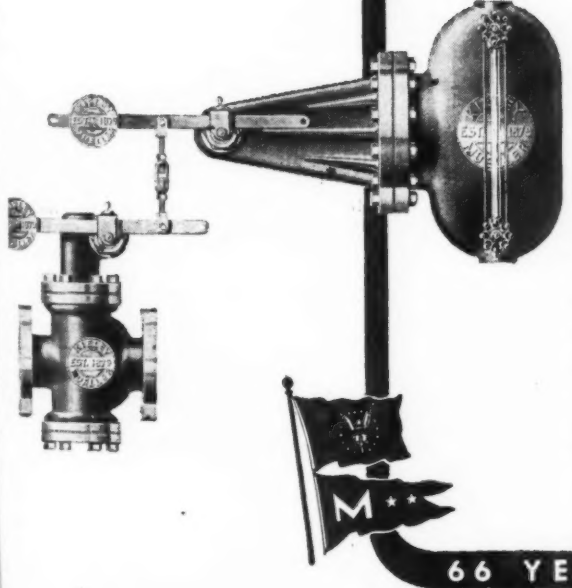


Years of experience . . . dramatized by a Gisholt high production turret lathe shown in contrast to a Gisholt machine of 1890.

THE PRINCIPLE

is the same – in 1890 – in 1945

BUT . . . the refinements are mighty important!



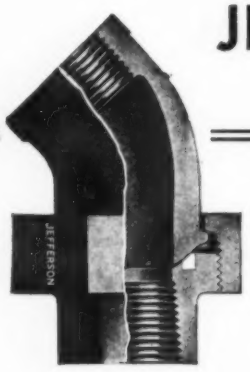
There's little difference in principle between the "belt driven screw machine" of 55 years ago and the ultra-modern Gisholt turret lathe of today. *But in practice* . . . ah! . . . 7 to 10 times the production per man-hour . . . heavier feeds . . . smoother cuts . . . more accurate work! Better machining with such greatly improved machines is partly the answer to the dependable efficiency of Kieley & Mueller Controls . . . but *experience* must get most of the credit. For Kieley & Mueller experience, like Gisholt's, inspires steady progress in design, production and performance. Type 250 Liquid Level Control is a typical example. For maintaining constant levels in open or closed vessels, there is no device more sensitive. The "pack-ezy" ball bearing stuffing box minimizes friction, is tight under pressure or vacuum, and may be repacked in the field with ordinary tools. Valve bodies have large open port areas, and removable and renewable seat rings. Sizes ½" to 6" with self-contained float cage. Yes, the principle of today's Kieley & Mueller Liquid Level Control is unchanged . . . *but the refinements are mighty important!* Write for Catalog No. 66.

KIELEY & MUELLER, INC.

MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879

2001 43rd St., North Bergen, N. J.

66 YEARS OF CONTROL PROGRESS



JEFFERSON
Specialty UNIONS

with the

RECESSED BRASS SEAT

Eliminate possible trouble points

Jefferson 45° Union Elbows are designed for use on lines which are not straight but which still do not have a full right angle bend. They are available with either All Female threads or Male and Female, and by taking the place of a straight union, nipple and elbow save two pipe joints as well as time, trouble and expense.

These and all Jefferson Unions offer the exclusive Jefferson feature of a Recessed Brass Seat which in effect gives a one-piece, brass-and-iron construction of permanent tightness. The location of the seat assures unrestricted, free flow in the pipe and full protection from contact with pipe ends that are screwed in too far.

Consult us or your nearest distributor on your piping problems. Ask for full information.

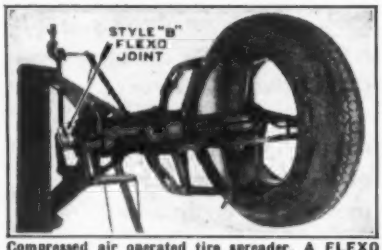
JEFFERSON UNION CO.

601 West 26th St., New York 1, N. Y.

Factories at

LEXINGTON 73, MASS. **LOCKPORT, N. Y.**

Locomotives or Tire Spreaders!



Compressed air operated tire spreader. A FLEXO JOINT is installed in the air line at the rear of the machine, which allows the tire casing to be revolved freely in either direction.

It's all the same to FLEXO JOINTS whether they are used to convey steam, air, water, oil, gas or other fluids and—they will handle any pressure up to 1350 lbs. superheated steam.

FLEXO JOINTS

have proven their ability to give unsurpassed service wherever flexible or swing joints are required for conveying steam, compressed air, water, oil and other fluids under high or low pressure. No matter how hard the service may be the uses for FLEXO JOINTS are limited only by the applications to which they can be put in your own plant. Send us a brief description of your requirements as we undoubtedly have a record of a similar installation and can give you definite information. Nominal first cost and extremely low maintenance cost have placed them in large and small plants throughout the world. Try them; know how inexpensive and efficient they are.

4 styles—standard pipe sizes from ¼ inch to 3 inches.

Your regular supply house has them or order direct from

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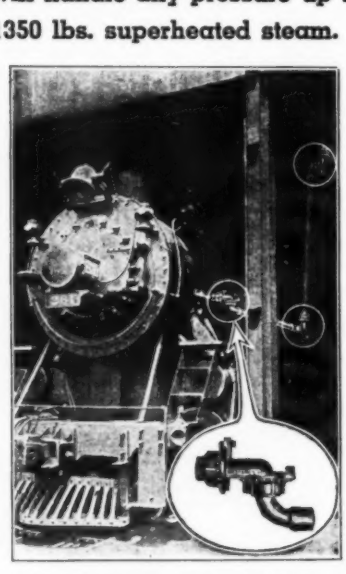


Steam blower line of pipe and FLEXO JOINTS. The flexibility of hose—the safety of pipe.

Power News

(*Continued from page* 182)

Local sections of Society of Automotive Engineers have embarked on a program of local war-emergency meetings to disseminate essential war-engineering information. Plans call for presentation, at one-day local-section meetings throughout the country, of technical papers originally scheduled for SAE national meetings, for making copies of all papers available to Society members and for subsequent publication of the papers, either complete or in abstract, in the *SAE Journal*. If the War Committee on Conventions should lift the ban on national meetings, the SAE expects to resume its national meetings' program.

Joint Army-Navy Termination Regulation is the bible for war contractors in rapid settlement of war contracts. A recent survey discloses that less than 40% of war contractors circularized had availed themselves of this publication. Contractors holding war contracts should be placed on the mailing list for the regulation and all subsequent changes. Contractors merely have to write to Joint Army-Navy Distribution Center, 90 Church St, New York, N. Y., Att of Lt E P Lull, for free copies.

Office of War Utilities' Power Div has authorized the installation of a 30,000-kw turbine-generator and boiler in the Green Bay plant of Wisconsin Public Service Corp and a 10,000-kw topping unit with boiler for the Horseshoe Lake plant of Oklahoma Gas & Electric Co. Capacity of the latter plant will be raised about 22,000 kw by the summer or fall of 1946.

New 16-mm Kodachrome and sound motion picture shows manufacture of Yarway products, how they operate and industrial applications. Prints are now available for employe groups, technical societies, engineering schools and other organizations from Dept M, Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa. Send your request on company letterhead, mentioning your position. Also advise approximate audience that will see picture and three possible dates for showing of film. If no standard projector and/or operator is available, Yarway will endeavor to supply either or both. There is no charge for the film or projection service.

Crane Packing Co announces adoption of an Employee Profit Sharing Trust. The plan provides for an annual contribution by the company to a bank acting as trustee. This is in addition to the regularly paid semiannual bonus and to the life, health, accident and hospitalization insurance now available to Crane employees without cost.

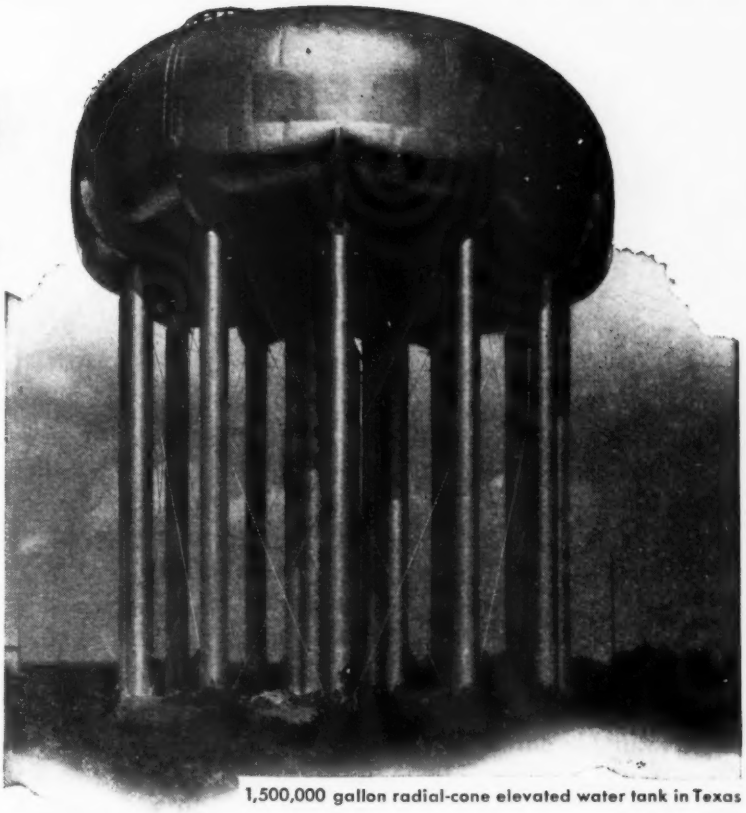
Builders Iron Foundry and its affiliates, Builders-Providence, Inc, Proportioneers, Inc, and Omega Machine Co, recently held a triple celebration to commemorate the company's 125th anniversary, to honor 270 employes having from five to 54 yr of service and to celebrate fifth Army-Navy E.

FOR TANK INTERIORS

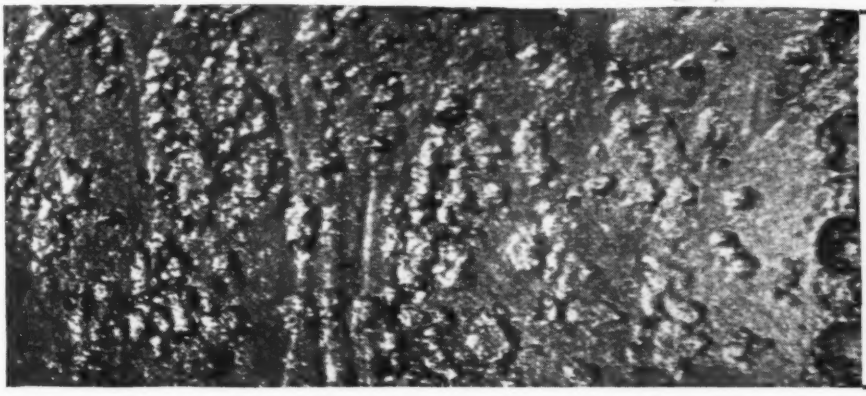
Corrosion Protection that Has Been Proved at Sea

Here is a corrosion-resistant coating for interiors of all types of cold-water tanks, steel cooling towers and all metal surfaces exposed to water under 125°F.

APEXIOR NUMBER 3 has earned a world-wide reputation in the marine field, having the longest record of success in protecting marine stern plates and condensers against the combination of salt water and electrolytic action.



1,500,000 gallon radial-cone elevated water tank in Texas



This is what happened to a cold-water tank *before* it was APEXIORIZED. But APEXIOR has kept it from getting any worse for nine years. It's an area of a cylindrical open-top steel reserve storage tank, containing potable Boston city water for ice-making. All internal surfaces, some badly corroded, were cleaned and given two coats of APEXIOR NUMBER 3 in 1935. Photograph was made after seven years. No touching up or re-coating has been required since. The coating remains in good condition.

COMPOSITION: APEXIOR NUMBER 3 is a shiny-black paint, a combination of asphalts (100%) dissolved in a suitable solvent. The deposited film when free of solvent is non-toxic and suitable for the coating of tanks to contain potable water.

To prepare for APEXIOR, clean surfaces thoroughly to bare metal — sand-blast if possible — then apply two coats of APEXIOR NUMBER 3 by hand brush. An original abrasive blast cleaning (never again necessary) provides a permanent maintenance base upon which APEXIOR protection can be established. APEXIOR is shipped for use as received — no thinner permitted.

Here's economical insurance against rust for any cold-water handling equipment. Get additional details today. Use the coupon below.

APEXIOR

Keeps new metal new . . . Gives old metal new life

The **DAMPNEY COMPANY** of America

protective coatings for

STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Massachusetts

Please send free Bulletin 1290.

Name.....

Company.....

Address.....

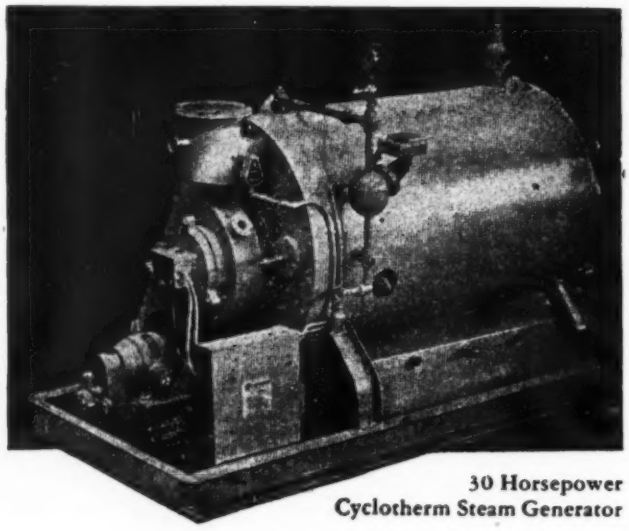
DOLLAR EFFICIENCY—work done per dollar spent—measures the value of steam generation

If you are planning immediate boiler installation or replacement, the efficiency and economy of a Cyclotherm Steam Generator will interest you. While the range of available units obviously cannot be on a peace time basis, Cyclotherm engineers will gladly cooperate in meeting your needs in power, processing or heating with available units.

Cyclotherm meets the dollar efficiency test through a wide power range (10 to 300 horsepower) with both oil and gas fired units. Its exclusive principles of combustion and design have proved Cyclotherm's dollar saving and dollar making capacity under most rigorous operating conditions.

Cyclotherms are fully automatic, sturdily built and completely self contained. They give years of trouble free service with a minimum of attention.

Detailed additional information will be supplied promptly upon request. Our engineers are available for consultation.



30 Horsepower
Cyclotherm Steam Generator

CYCLOTHERM
STEAM GENERATOR

AMES IRON WORKS
OSWEGO . . NEW YORK . . BOX 702

APPOINTMENTS

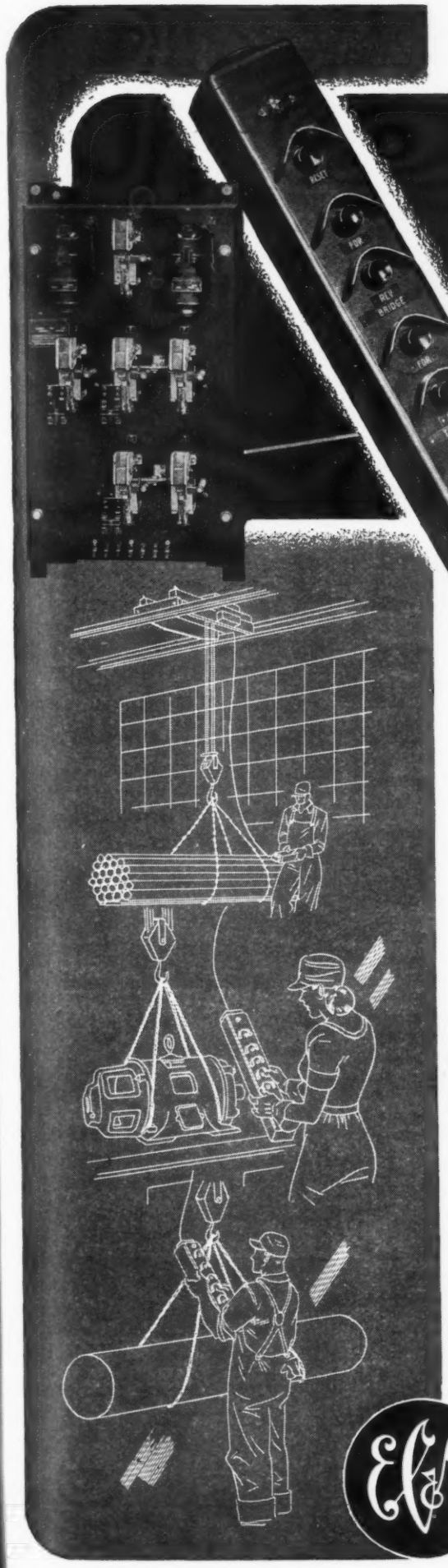
Cooper-Bessemer Corp promotes **C M Bovard** to design engineer and **Ralph H Schlosser** to chief draftsman . . . **H C Lenfest** has been made vice-president in charge of **Enterprise Engine Co's** New York City offices at 44 Wall St . . . **Briggs Clarifier Co** announces expansion of its sales activities: **Manning Packing & Supply Co** handles distribution in Ore. and southern parts of Wash.; **Hendrie & Bolthoff Mfg & Supply Co** in Wyo., Colo., N. M. and western Neb.; **M F Hampton Co** in Okla.; **Hoffman Supply Co** in northern Tex.; **LaGrave & Co** in central and southern Miss., southern Ala. and northwestern Fla.

Westinghouse Electric & Mfg Co names **Robert E Blasen** application engineer for San Diego area. **C F Jensen, Jr,** has been appointed district engineer of Northwestern district of lamp div. **George H Woodard** becomes manager, **W F Boyle** sales manager, **Reinout P Kroon** manager of engrg dept and **S S Stine** mfg manager of newly formed aviation gas turbine div. **Westinghouse Electric Elevator Co** appoints **Ross Rathbun** manager of expanded air conditioning div, **Walker G White** manager of new elevator div and **G F Begoon** manager of precipitron dept of air conditioning div.

Westinghouse Electric Supply Co names Arthur P Hammerstrom apparatus and supplies manager in Central district, succeeding **H E Bracke,** who was transferred to Cincinnati office. **A L Goeke** has been made service manager of Tulsa, Okla., branch. **O A Bruneau** has been appointed Duluth, Minn., branch manager, **L G Hardy** Southeastern district appliance manager, **C W Spengler** acting manager of Jacksonville branch, **E L Houston** acting manager of Tampa branch, **S R Clark** branch manager at Charlotte, N. C., **O C Rhodes** acting manager of Columbia, S. C., and **R E Hallman** acting manager of Greenville, S. C., branch.

Elliott Co appoints **H S Pahren** plant manager of Ridgway div and **V H Baker** plant manager and product engineer of Lagonda div. **W A Elliott** was elected executive vice-president, **R B Smith** vice-president in charge of engrg, **M G Shevchik** secretary and treasurer. **F W Dohring,** general sales manager, was given added responsibilities as assistant to executive vice-president . . . **General Electric Co** named **H E Dunham** manager of patent dept and **Harry R Mayers** as assistant manager . . . **F G Schrans** retired as vice-president of Baldwin Southwark div of **Baldwin Locomotive Works,** but will still act in a consulting capacity. **R G Allen** has been appointed general manager of same div.

Kennedy Van Saun Mfg & Engrg Corp announces appointment of **C T Fulshaw** as chief engineer of steam div. Mr. Fulshaw was formerly connected with engrg dept of Babcock & Wilcox Co and Foster Wheeler Corp . . . **Allis-Chalmers Mfg Co** elected **J H Collier** a director. **F S Cockburn** has been reappointed field representative in



A COMPLETE NEW LINE OF *Push Button* CONTROL

for D-C FLOOR OPERATED CRANES

Compact—Easy to mount—Easy to wire
Provides Accurate Speed Regulation

THIS EC&M standardized line of controllers is designed for (1) accurate inching, (2) compact mounting, and (3) minimum collector-bar requirements. They can be conveniently installed along the crane girders or mounted on the trolley, as required.

They have all the advantages of the well-known EC&M Control for *cab-operated* cranes. Acceleration is by the TIME-CURRENT method. Contactors are of the heavy-duty, magnetic type. Resistors are carefully proportioned for low-torque hoisting of light loads and for smooth acceleration of bridge or trolley. All motions can be controlled from a single, pendant, master-station complete with Pilot Light, Reset Button, and Emergency Stop, Double Pole control-circuit, Toggle Switch with two Push Buttons for each motion. Individual rope-operated Master Switches for the various motions are optional.

Bulletin 922 gives complete data, description, dimensions, etc. Send for your copy today.

THE ELECTRIC CONTROLLER AND MANUFACTURING CO.

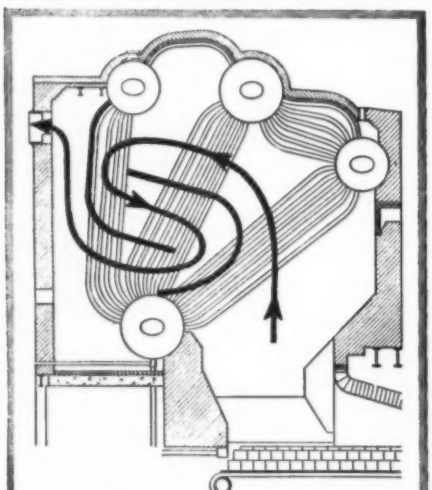
2698 East 79th Street **Cleveland 4, Ohio**

Only ENCO BAFFLES offer you all these advantages

These important fuel-saving, maintenance-reducing features are obtainable with Enco boiler baffles — and only with Enco baffles.

- Streamlined gas flow
- Uniform gas flow
- Elimination of bottle necks
- Reduced draft losses
- Higher heat transfer
- Cleaner heating surfaces
- Less use of soot blower
- Special provision for expansion
- Easy tube replacement
- Adaptable to any water-tube boiler, fired by any fuel

Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.



Canada: F. J. Raskin, Inc., 370 Rachel E., Montreal, P. Q.

THE ENGINEER CO.
Enco 75 West St. New York 6, N. Y.

Peru . . . **Franklin Farrel, Jr,** resigned as chairman of board of directors of **Farrel-Birmingham Co** and **A A Cheney** succeeds him. Mr. Farrel continues as director and chairman of finance comm. **L D Chirgwin** was made vice-president in charge of mfg and **Franklin Farrel, III,** secretary and assistant treasurer. **C F Schnuck** and **W M Fraser** are directors.

Worthington Pump & Machinery Corp announces appointment of **George Steven** as executive engineer of its Buffalo Works. **Harold W Whiting** becomes chief engineer of Buffalo Works' compressor div . . . **Lunkenheimer Co** elected following officers and directors at annual meeting: *President and General Manager:* F P Rhame *First Vice-President and Assistant General Manager:* H E Lunken *Vice-President, Sales:* H A Burdorf *Secretary:* C W Burrage *Treasurer and Controller:* C C Isekeit *Directors:* H A Burdorf, H G Frost, C C Isekeit, C M Jacobs, E P Lunken, H E Lunken, F P Rhame . . . **Ohio Injector Co** has appointed **J W Greene** general sales manager.

Enterprise Engine Co appoints **H C Lenfest** vice-president in charge of New York City offices at 44 Wall St . . . **Dresser Industries, Inc,** opened its new centralized administrative offices at 1130 Terminal Tower, Cleveland. Consolidated domestic and export sales offices for Dresser member companies are now located at 800 Chanin Bldg, New York, N. Y. . . . **W G Kerr Co,** representatives for **Reeves Pulley Co** in western Pa. and part of W. Va. and for **Foote Bros Gear & Machine Corp** in western Pa., moved to 520 Oliver Bldg, Pittsburgh 22, Pa.

Gardner-Denver Co has established the main office of its export dept, formerly in Quincy, Ill., in New York City . . . **L J Promen** has been appointed to represent **Modine Mfg Co** in northern Wisconsin and upper Michigan . . . **Henszey Co** announces that **J O** and **C U Martin,** 637 Minna St, San Francisco 3, Calif, have been appointed northern California agents for Henszey specialties . . . **General Controls Co** announces the completion of another step in an expansion program which includes a new office building and a processing plant in which heat treating, anodizing, mechanical deburring, sand blasting and painting dept are housed . . . **Crotty Co,** 55 W 42nd St, New York, N. Y., has been appointed distributors for **Todd Combustion Equipment.**

Toledo Pipe Threading Machine Co announces that **Clemens A Martus,** 76 Withington Rd, Newtonville, Mass., is now representing them in New England and New York State . . . **Fort Pitt Steel Casting Co** appoints **N K Daerr** sales manager, **S B Nicholson** associate sales manager, **H J Hatt, H E Rankin** and **M L Murray** sales engineers . . . **Electric Storage Battery Co** has made **J A Cronk** manager of Atlanta branch.

Philco Corp announces formation of **Philco Service,** a world-wide organization of appliance servicemen to establish new high standards of work. Membership is

TECTYL STOPS RUST!

No ifs or buts—

Tectyl, applied to the surface of metal, STOPS rust. The thin film (transparent, so you can see the metal all the time) seals out the possibility of corrosion for as long as two years. Tectyl is economical to use—easily applied by spraying, dipping, brushing, or flushing—and it can be removed quickly and cleanly with kerosene.

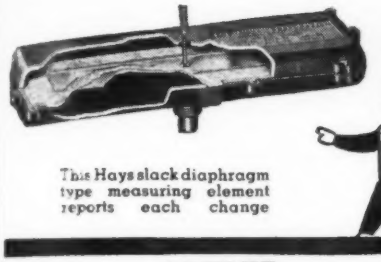
VALVOLINE OIL COMPANY
431 Main St., Dept. 29 E, Cincinnati 2, Ohio
Refinery at Butler, Pennsylvania
General Offices, Cincinnati, Ohio
New York - Atlanta - Detroit - Chicago - Los Angeles
Vancouver - Washington, D. C.

There is a TECTYL product for EVERY rust problem

ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!

HOW HAYS COMBUSTION CONTROL

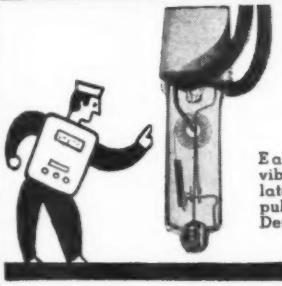
gives you 1 accuracy • 2 sensitivity • 3 speed • 4 power



This Hays slack diaphragm type measuring element reports each change

1 ACCURACY A CONSPICUOUS FEATURE

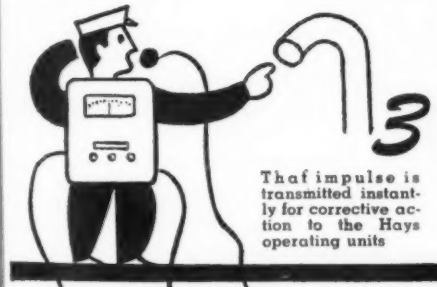
of Hays elements for measuring the minute changes constantly taking place in variable combustion factors—the Hays diaphragm type measuring element for draft and low pressures; and Hays Metallic Bellows for measuring steam or high pressures in air, water or oil.



Each measured vibration is translated into an impulse by Hays Pilot Device

2 TO CONVERT EACH MEASUREMENT

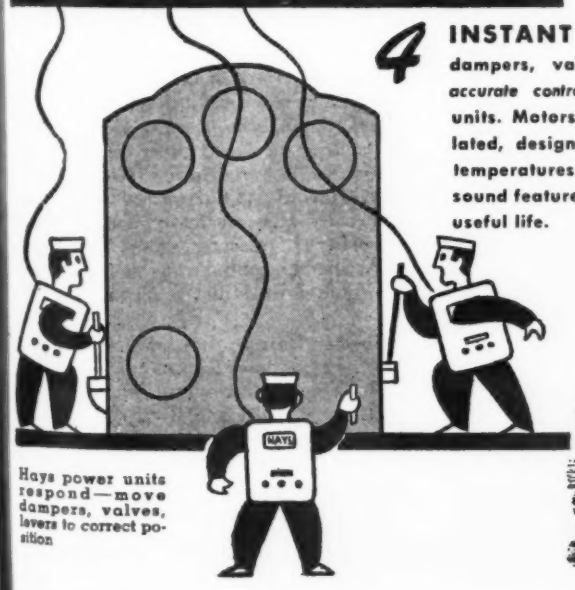
into an impulse calls for a pilot device of extreme sensitivity. The Hays pilot consists of two mercury switches magnetically operated. Fully enclosed, their contacts are effectively protected from dust, dirt, moisture; and blanketing with nitrogen prevents oxidation—a guarantee of long life.



That impulse is transmitted instantly for corrective action to the Hays operating units

3 THAT IMPULSE IS TRANSLATED

into corrective action, delivered instantly to the remote power units operating fuel feeder and air supply by electrical transmission. The Hays system possesses excessive starting torque—25 to 75 per cent higher than moving power—ample to overcome inertia and create quick action.



Hays power units respond—move dampers, valves, levers to correct position

4 INSTANT ACTION FOR MOVING

dampers, valves or levers *to the right point for accurate control* is the function of Hays power units. Motors are fully enclosed, effectively insulated, designed for installation in high ambient temperatures. Manual operation is available. Many sound features assure easy maintenance and long, useful life.

You SEE the 12 Vital Facts of MODERN COMBUSTION CONTROL in HAYS SALES VISUALS

The most comprehensive, most understandable explanation of automatic combustion control ever compiled. Ask the Hays representative to show it to you.

1. The purpose of Combustion Control.
2. How that Purpose is accomplished—3 methods of control.
3. What results can be expected of each.
4. Elements of a *good* control system.
5. Elements of a good controller.
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
8. How Automatic Combustion Control operates.
9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

This is the simple, dependable, automatic system that is saving big sums for industry of every kind—saving many man-hours, saving fuel, doing a *better job*, more dependably: Hays Electrical Combustion Control. A sensible way to see how it will help your business is by means of the Hays Visual Presentation. A line to us will arrange it.

The HAYS CORPORATION
SINCE 1921
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

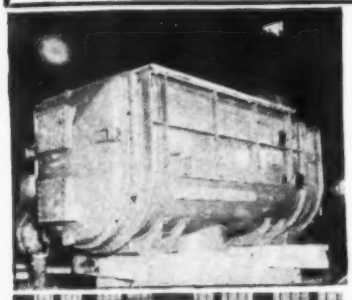
HEAT TRANSFER PRODUCTS

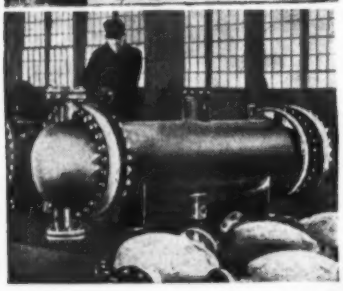
INCORPORATED

ENGINEERS 90 West Street

MANUFACTURERS New York 6, N. Y.

West Coast Representative
Harry W. Parsons, Inc.
24 California St., San Francisco 11, Cal.





STEAM JET AIR EJECTORS

●

STEAM CONDENSERS

●

EVAPORATORS
SELF DE-SCALING
(Patented)
VERTICAL COIL TYPE

●

DISTILLERS

HTP

●

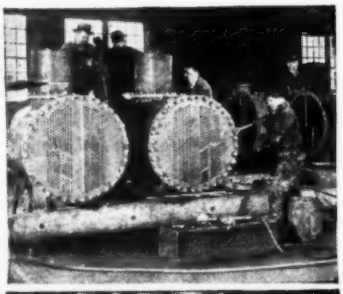
COOLERS
FRESH WATER
LUBRICATING OIL

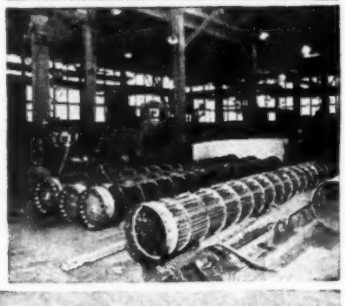
●

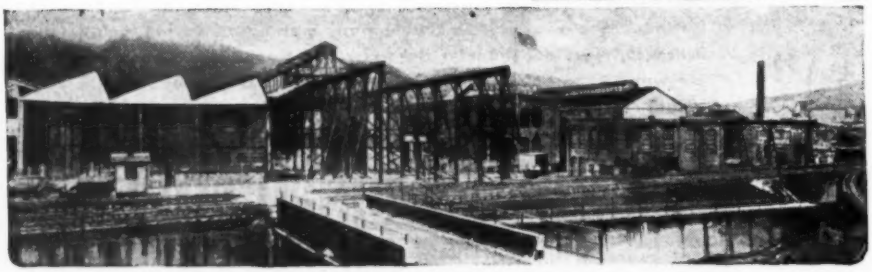
FUEL OIL HEATERS

●

FEED WATER HEATERS
LOW PRESSURE HIGH PRESSURE







PLANT AT CARBONDALE, PA. (90,000 Square Feet)

open to individual servicemen, dealers' servicemen and dealer organizations, who will be informed as to latest technical developments and will be instructed in maintenance and repair work. To take care of export packing of spare parts for radio and electronic equipment made in its Philadelphia plants for Army and Navy, Philco Corp has leased facilities formerly occupied by Hunter Mfg Co at Croydon, Pa., and it will be under supervision of **Thomas Brown.**

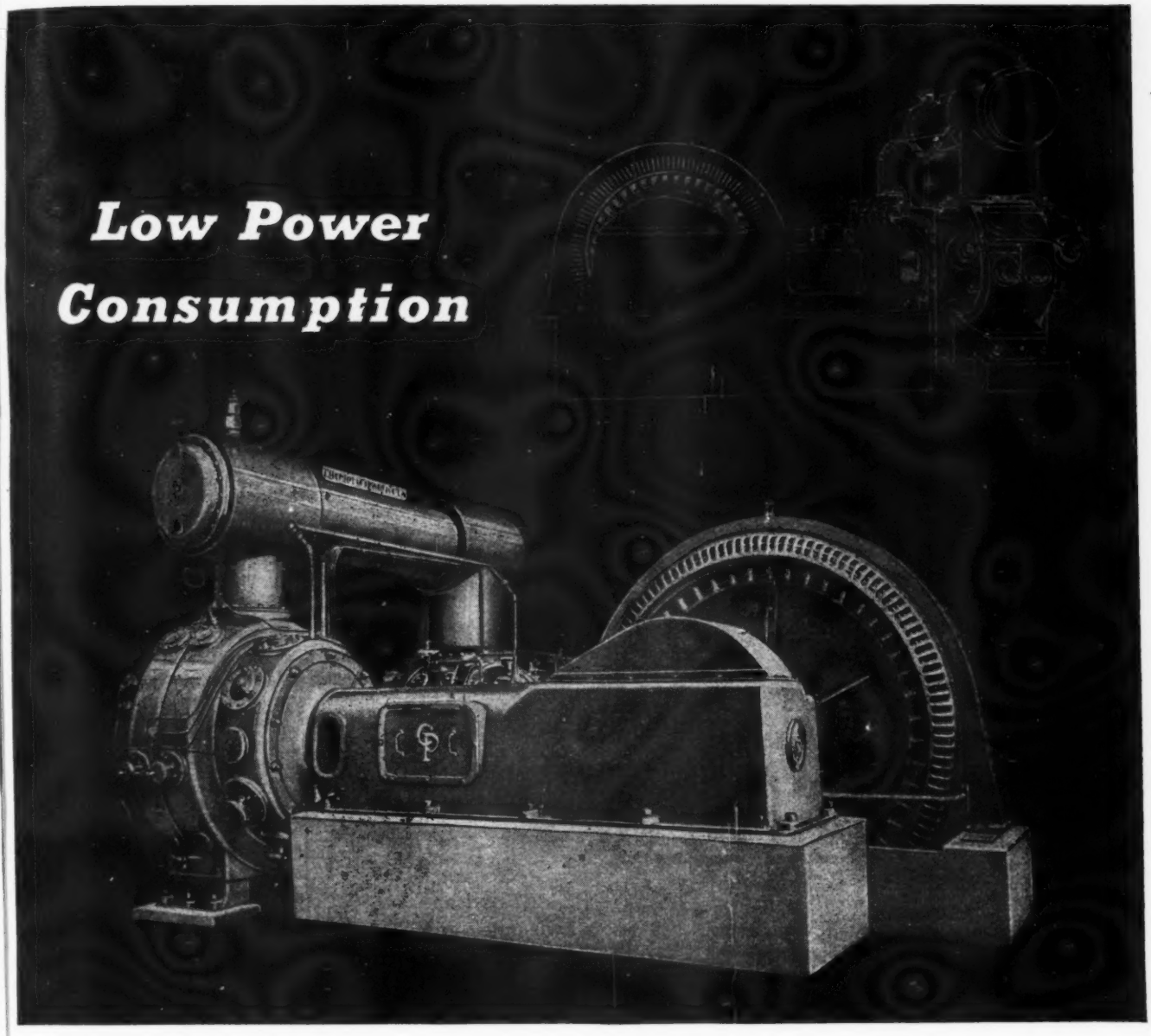
Wickwire Spencer Steel Co elects **A G Bŭssmann** vice-president in charge of sales. New England traffic div has been moved to New Bond St, Worcester 6, Mass. **J S Sampson** has been promoted to assistant of general traffic manager. **D J Carey** has been appointed div traffic manager of New England div . . . **America Chain & Cable Co** appoints **E J Flood** general district sales manager for Chicago sales territories. **W E Moore** was made district sales manager for New York district of American Cable div . . . **Macwhyte Co** appoints **R P Tyler** general sales manager.

B F Goodrich Co has named **Ward Keener** assistant to president and **Dean E Carson** director of business research . . . **United States Rubber Co** appoints **Luther B Martin** director of tire development and research, with headquarters at Detroit . . . **International Nickel Co** announces formation of following newly created sections of development and research div: **Industrial chemicals section,** with **O B J Fraser** in charge; **corrosion engineering section,** with **F L LaQue** in charge; **iron and non-ferrous casting section,** with **D J Reese** in charge.

Detrex Corp, alkali div, transfers **J N Cooper** to New England states, where he will supervise sales of alkali and emulsion cleaning materials . . . **Pennsylvania Salt Mfg Co** appoints **A S Woodard** assistant chief engineer, **J P Evans** senior electrical engineer, **R R Walden** senior mechanical engineer, **P F Dorney** senior civil engineer, **J W Dadley** senior design engineer . . . **Eagle-Picher Lead Co** has been changed to **Eagle-Picher Co.**

Walter Kidde & Co appoints **John J Caldwell** as their insurance relations engineer and purchases capital stock of **Youngstown Miller Co.** Orders on hand will continue to be filled under direction of **F L Gerin,** who becomes vice-president and general manager. Other officers of the new subsidiary are **John F Kidde,** president, **Harold A Cartier,** vice-president. **G Crosby Hiss,** secretary, and **William Deyerberg,** treasurer and comptroller. **R E Strobel** continues as sales manager for Youngstown Miller products.

Economy Pumps, Inc, elected following officers at last annual meeting: *President:* R H Thomas *Vice-Presidents:* L G L Thomas, H R Ryan, R H Thomas, Jr *Treasurer:* L V Thomas *Secretary:* E T Drinkuth *Directors:* J R Bullock, E T Drinkuth . . . **Buffalo Forge Co** appoints **C C Cheyney** sales manager . . . **Young Radiator Co** announces that **H J Kinkade** is now a member of contract product



BUILT INTO CP CLASS O-CE COMPRESSOR

THE low power consumption of the heavy-duty Chicago Pneumatic Class O-CE Compressor is the result of large area, durable, quick-acting Simplate valves . . . streamlined air passages . . . multi-step capacity regulation . . . thoroughly effective intercooling and water jacketing and efficient lubrication.

CP Class O-CE Compressor is of the horizontal, double-acting, water-cooled type with direct-mounted synchronous motor drive. Capacities range from 350 c.f.m. to 10,000 c.f.m., 80 pounds to 125 pounds pressure. Other sizes available for lower and higher pressures and for other types of drive. Write for Bulletin 726.

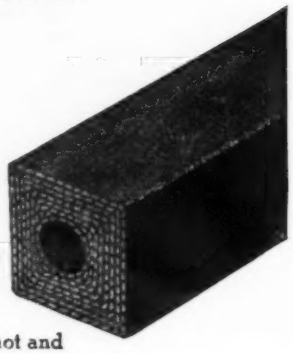
★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL CP COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

BELMONT PACKINGS

BELMONT 9 . . . For all hydraulic services from low pressures to extremely heavy duty, hot and cold water.



BELMONT 319 . . . For hot and cold water rods and plungers.

FOR WATER

Belmont 319 Hollow Center Packing and Belmont 9 Special Hydraulic Packing will properly seal stuffing boxes of heavy hydraulic units such as presses, accumulators, draw-benches, squeezers and pressure pumps.

The hollow center of Belmont 319 Packing, provides a point of least resistance for expansion and extraction. Hence, the packing will "breathe" toward the "hole" as varying conditions of service within the stuffing box are exerted upon it.

Belmont 9 combines two distinctive materials made into one integral packing. The channel not only acts as a wiper, but as a protection to the inner body of flax . . . these two packings used in alternate rings make an ideal combination set.

Authorized Belmont distributors are located in every large industrial center to make recommendations on your requirements, or if you desire, a request on your company letterhead will bring a copy of the Belmont Catalog displaying the complete Belmont Packing Line in detail.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

div staff . . . **Foxboro Co** has made **W A Rock** resident engineer in Corpus Christi area, under direction of Houston office. **J M Tuttle** has joined staff of engineers at Pittsburgh office . . . **Climax Industries** appoints **J H Seippel** vice-president, with headquarters in Chicago . . . **Aeroil Burner Co** has made **Bernard Gould** general sales and advertising manager.

Detroit Edison Co elects **J H Walker** vice-president . . . **George E Doying, Jr,** has been appointed special assistant to Director Edward Falck of **Office of War Utilities** . . . **O L Hooper** has been named chief of fuel and allocations branch, succeeding **Alexander Macomber,** who will devote full time to OWU's gas div. **Clifton B Gleaves** was named deputy chief of fuel and allocations branch . . . **Basil E Prentice** has been appointed superintendent of claim dept of **Hartford Steam Boiler Inspection & Insurance Co,** succeeding **A L Thalheimer,** who has retired . . . **Samuel J Gates, Robert H Weiss** and **Parker A Moe** have formed a partnership, known as **Gates, Moe & Weiss,** 611 N Broadway, Milwaukee 2, Wis., for engineering practice.

B F Goodrich Co adds to its line of industrial hose a complete series of Lonn blow guns, whose fingertip control is made possible by rubber. Company will handle exclusively, through distributor channels, nation-wide sales of these valves made by Lonn Mfg Co, Indianapolis.

CURRENT AWARDS

Federal Mfg & Engrg Co has received four stars for its "E" flag. **Clark Bros Co, American Foundry Equipment Co** and **Heller Bros Co** have been awarded three stars.

Economy Pumps, Inc, Flint & Walling Mfg Co and **Hollingsworth & Whitney Co** have been given Army-Navy "E" flags. **Andrea Radio Corp** has received the same honor.

OBITUARIES

James Lincoln Ashley, 76, director of International Nickel Co of Canada, Ltd, died Mar 6 in New York City.

Herbert R Allen, 50, New York district manager of Square D Co, died Mar 14.

C F Burgess, founder and director of Burgess-Manning Co, died Feb 13.

Peter E Riva, 49, assistant watch engineer at Readville, Mass., steam plant of New Haven Railroad, died at Hyde Park, Mass., on Mar 15.

Morton S Cheney, 74, chief operating engineer of generating station of Lyndonville, Vt., municipal electric light dept for past 43 years, died on Mar 17.

William Greene Havens, employed for many years as a stationary engineer at industrial plants in Providence, R. I., died recently at Rhode Island Hospital.

Complete PUMPING UNITS

...built, guaranteed, and serviced by ONE manufacturer

Pump illustrated is single-stage, split-case centrifugal.

Fairbanks-Morse complete pumping units offer you much more than sustained high efficiency. There are in addition these three vitally important advantages:

1. ***Combined Responsibility.*** Designed and built in one factory, pump and driver (motor or engine) are perfectly matched and covered by a single guarantee.
2. ***Successful UNIT Performance.*** Tested in one plant under expert engineering supervision, pumps and drivers assure a superior result to the buyer.
3. ***Service from One Source.*** No questions about who is to make any required repairs or adjustments.

You can get these major advantages from Fairbanks-Morse... because Fairbanks-Morse designs and builds all components of an outstanding line of complete pumping units. To see a qualified engineer about any pumping job, write Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Ill.

BUY WAR BONDS FOR KEEPS

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

THE ALLPAX CO., INC.
Mamaroneck, N. Y.

•

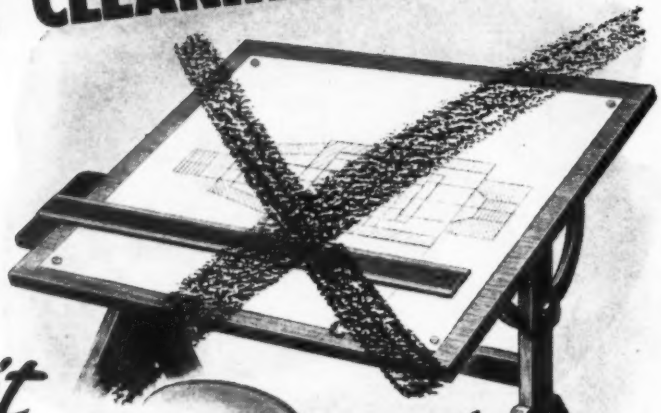
Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all — economically, efficiently — tightly — simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

Most TUBE CLEANING PROBLEMS



don't require special designs

The solution of special and apparently difficult tube-cleaning problems is really easy with Wilson Tube Cleaners—in eight or nine cases out of ten, it can be done without designing new or unconventional motors, cutter-heads, cutters or accessories. A review of literally thousands of special tube-cleaning problems presented to Wilson engineers shows that 80% to 90% were satisfactorily solved by selecting the right combination of Wilson parts. In other words, a combination of one of the many Wilson motors and cutter-heads or brushes, plus accessories such as universal joints, shafting, etc.—solved the problem.

A copy of The "Tube Cleaners Check-List" will help you make this selection. It contains a selection guide, showing many of the standard Wilson motors and cutter-heads—with ideas as to when they can be used most efficiently. In addition, it gives valuable hints on operation and maintenance of tube cleaners—plus a handy table of Wilson Tube Cleaner sizes. Your copy will be sent on request and without obligation.

**Modern tube-cleaners for the problems of today.*

wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

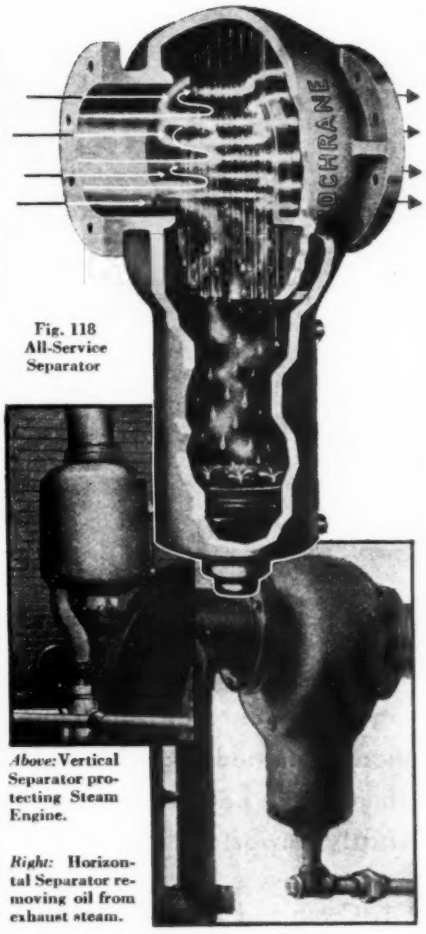


Fig. 118
All-Service
Separator

Above: Vertical Separator protecting Steam Engine.

Right: Horizontal Separator removing oil from exhaust steam.

Avoid the High Cost of

DIRTY, WET, OILY STEAM

Keep It Clean and Dry with

COCHRANE

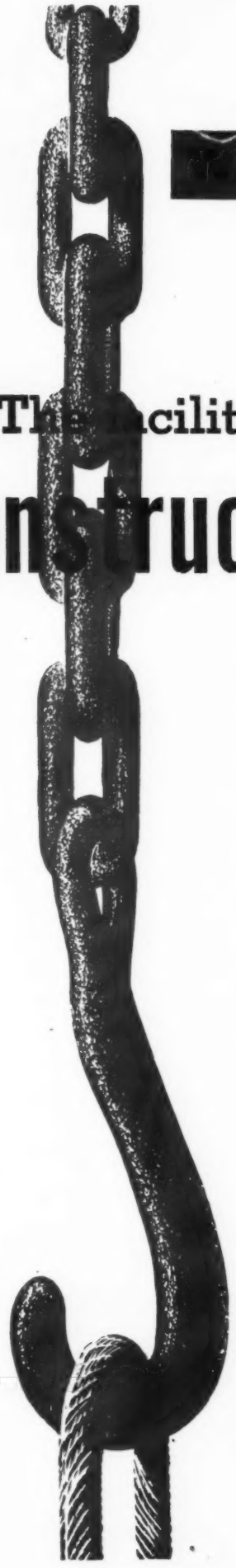
ALL-SERVICE

SEPARATORS

You can completely remove moisture and solid entrainment from dirty, oily, wet steam, air and gases by installing Cochrane Separators. Complete purification is assured, due to exclusive design of baffles and ports which produce a direct, unrestricted fall of entrainment, prevent the purified steam from passing over the drip area, and minimize pressure loss by means of extra large port areas.

Write for details.

COCHRANE CORPORATION
3106 N. 17th St., Philadelphia 32, Pa.



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SHAW can fill them

Quickly, Dependably

●The facilities of our

Construction Division

are adequate to handle piping projects of any size or description, regardless of location . . . either on the basis of entire fabrication in the field or prefabrication and field erection. Our facilities today are backed by our fifty-two years of succcessful experience. Wire, write or phone for information.

FLETCHER H. GROW
Construction Manager

SHAW
Pre-Fabricated Piping

BENJAMIN F. SHAW COMPANY
2nd and Lombard Streets Wilmington 99, Delaware

Known since 1893 for Dependable Delivery and Quality Prefabrication and Piping Installations

Brush Away Refractory Troubles

SAVERITE REFRACTORY COATING

Applied with brush. Binds old cracks and loosened brickwork. Prolongs life of old, wornout refractories.

FILL OUT AND MAIL

SAVERITE ENGINEERING COMPANY

1029 Clinton Street, Hoboken 3, N. J.

Send details of Saverite Refractory Coating to

Name .....

Position .....

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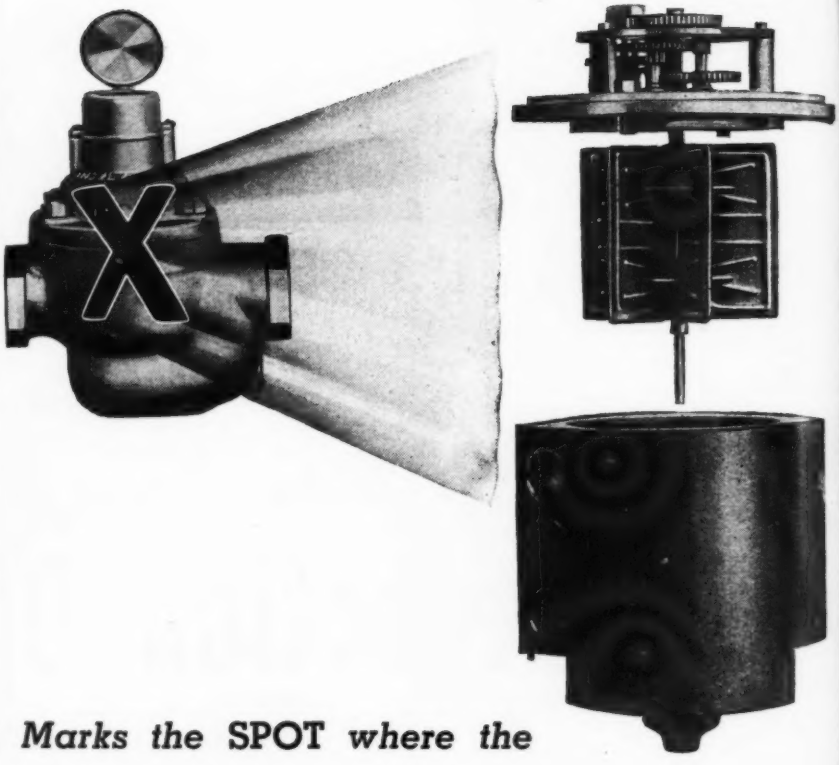

Marks the SPOT *where the*

HENSZEY FEED WATER METER

gets its ACCURACY *and* DEPENDABILITY

Notice the simplified, rugged construction of the inside mechanism of the Henszey Meter. The rotor (directly connected to the gear train) fits into the measuring chamber without close clearances. Bearing surfaces, shafts and bushings subject to friction and hard wear are made of tough, long-wearing Stellite. Calibrations of the straight-reading horizontal register can be made to read in gallons, pounds, or cubic feet at any specified temperature.

Yes, that's why Henzsey Meters are used for dependable, accurate measurement of boiler feed water, boiler blowdown, condensate, chemicals and other similar liquids. What's your hard-to-measure problem? Write today for a practical answer from Henszey.

HENSZEY CO. Dept. D5 Watertown, Wis.

HENSZEY

FEED WATER METERS

Continuous Blowdown ● Distillation Systems ● Heat Exchangers

Flow Indicators ● Boiler Feed Regulators ● Proportioning Valves

TIME-TESTED HIGH PRESSURE PACKINGS

These packings are now constructed with new synthetic compounds...Choose either style—210 Rubber BACK construction or 212 Rubber CORE construction.

Write today for details

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s Angeles 21, California	720 Mateo Street

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New Orleans 4, Louisiana	418 Common Street
New York 13, New York	100 Sixth Avenue, near Canal
Philadelphia 8, Pennsylvania	401 North Broad Street
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San Francisco 7, California	156 South Park
Seattle 4, Washington	2207 First Avenue, South
St. Louis 3, Missouri	1407 Pine Street
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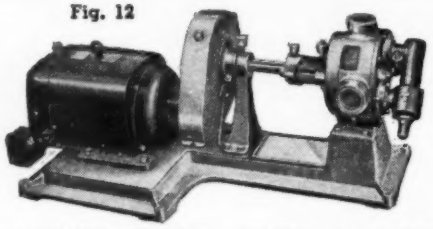
Wilmington, California	524 North Avalon Boulevard

1945

VIKING... THE PUMP SPECIALLY BUILT FOR

Fig. 12



5-10-18-20-35-50-90 GPM capacities—other Motor drive units from ½ to 1050 GPM.

Light or Heavy Liquids

Far more rotary pumps are built in the Viking design than any other. It is the approved style.

Viking Pumps are specially built for handling all types of light or heavy liquids. Many capacities to choose from. All give dependable, carefree service.

For complete information about Viking Pumps widely used in the power equipment field, write for Bulletin Series 800. It's free and will be sent to you by return mail.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA

CONNERY CONSTRUCTION CO.
SECOND & LUZERNE STS. PHILADELPHIA

Strip Paint From Your Transformer without laborious scraping

By Using This Oakite Method

Now in wide use by many power and utility companies, the Oakite Hot Flow-On Method is proving remarkably effective for stripping paint from transformers and similar equipment. No laborious hand-scraping is required. With this easier Oakite method, you can conserve manpower for other more important maintenance work. You can also save time. Oakite paint-stripping is safe . . . thorough.

Also Ask About These Jobs

When sending for details on Oakite paint stripping, ask also for full information on specialized Oakite materials for descaling and cleaning Diesel cooling systems, oil coolers, feed water heaters and surface condensers. There's no obligation. Write today.

OAKITE PRODUCTS, INC.
23 Thames St., NEW YORK 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE — Buy Bonds for Victory
Specialized cleaning
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

RE-CIRCULATE AND SAVE

If you *always* have enough heating or cooling supplied to the job, you will at times have plenty left over which is too often thrown away.

Sarco controls recirculate the unused heat or cold.

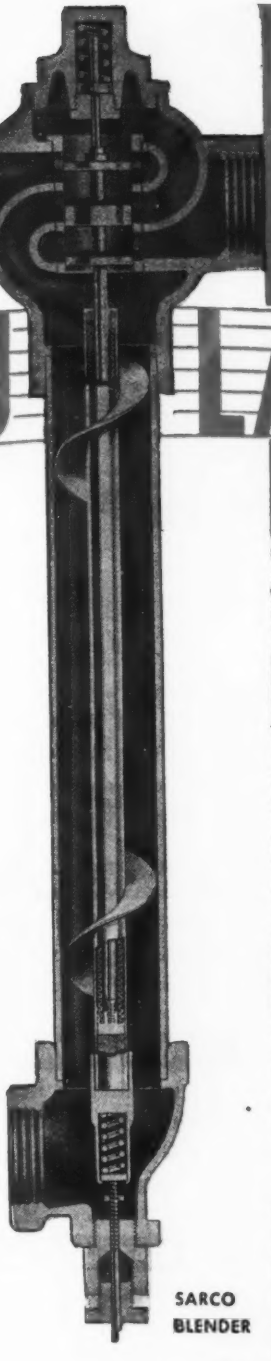
For instance, the president of a large Chicago plant says:

"We were wasting metered water, losing on our air compressor efficiency and throwing heat away until we heard about the Sarco Cooling Control.

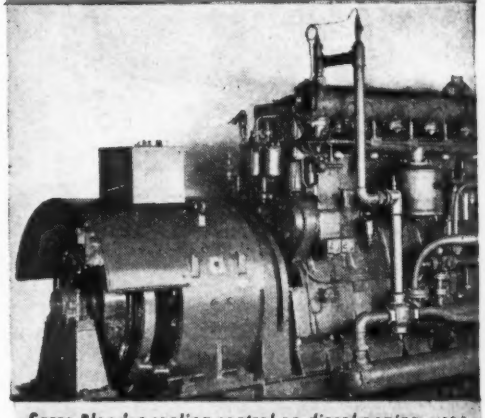
"Now the compressor cooling water is maintained at 110 degrees at all times. We use less water—get greater compressor efficiency. The warm water from the compressor is now sent over to the tanks in our washroom which are automatically held at a temperature of 110 degrees.

"Our relations with the Sarco Company have been both pleasant and profitable."

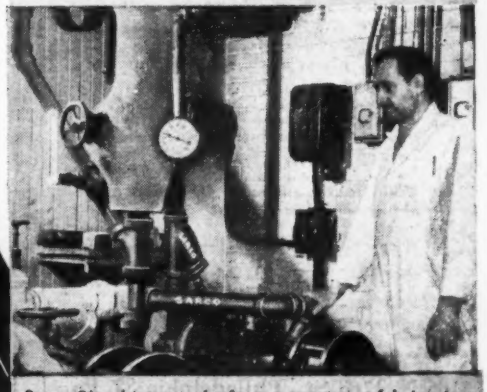
Sarco recirculating controls are also used extensively for condensers, Diesel engines, unit coolers and sewage digesters. Ask for Catalog No. 700.



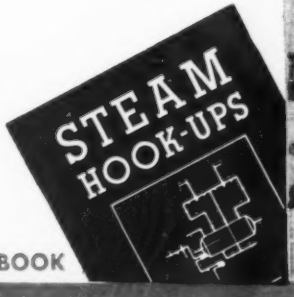
SARCO BLENDER



Sarco Blender cooling control on diesel engine; uses less water, gives higher engine efficiency with less oil and maintenance cost.



Sarco Blender controls the temperature of brine in dairy.



84 ASK FOR THE SARCO HOOK-UP BOOK

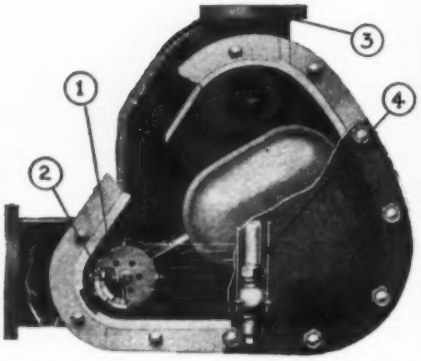
SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

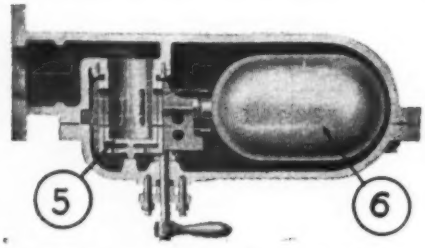
SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

Extraordinary Discharge Capacity



COCHRANE DRAINER



1 Valve absolutely balanced; does not bind or stick; water sealed; never leaves its seat; self-cleaning; has large ports for handling water rapidly and less operating pressure is required to expel condensate; pilot valves are unnecessary; no stuffing boxes, packings, springs or links; valve can be held open by handle on cover.

2 Valve Seat; a sleeve with longitudinal ports; removable after loosening screws.

3 Inlet at top; no possibility of trap becoming air bound; deflector prevents entering water from striking float.

4 Gauge glass, with guards and try cock.

5 The Rotary Valve Seat is attached directly to float stem; one moving element.

6 Upon taking off cover, the float and attached valve lift out at once.

Write today for further particulars

COCHRANE CORPORATION
3106 N. 17th St., Philadelphia 32, Pa.

AMERICA'S FASTEST SELLING BEARING METAL

WHY does MAGNOLIA ANTI-FRICTION METAL out-sell all other maintenance bearing alloys? There are three reasons:

MANY APPLICATIONS Having the lowest coefficient of friction of any known bearing metal, it provides the best lining for nine out of ten applications.

PRE-WAR COMPOSITION While many bearing metals have disappeared from the market, MAGNOLIA ANTI-FRICTION is still available. And, furthermore, its composition remains unchanged.

IMMEDIATE DELIVERY Your local distributor carries this metal in stock. He can sell to you without a priority. No fuss . . . no delays.

The next time bearings need relining, why not use this well known, widely accepted metal?

MAGNOLIA METAL COMPANY
18 West Jersey Street
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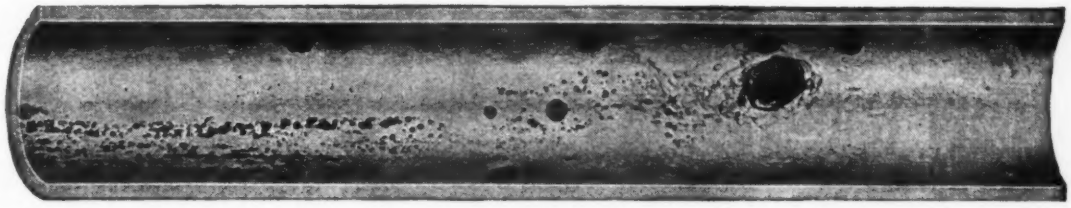
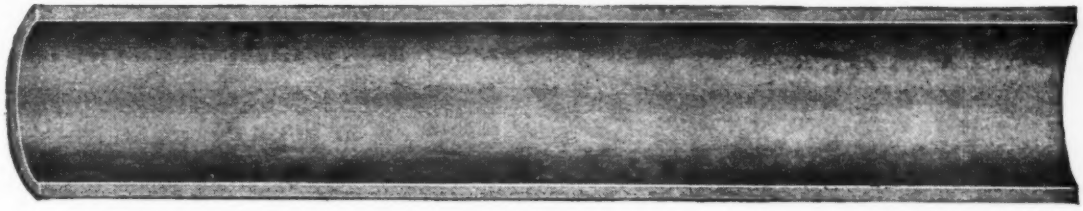
MAGNOLIA METAL CO. OF CANADA, LTD.
2028 Manufacturers Street
Point Ste. Charles, Montreal

MAGNOLIA BEARING METALS

This plain Admiralty tube *failed* from dezincification



This Chase Antimonial Admiralty* *still* in good condition



*U. S. Patent No. 2,061,931

yet they were taken from the **SAME** *condenser tube bundle!*

ABOVE you see two condenser tubes (enlarged). They have been in service the same length of time, in the same condenser bundle. Yet *look* at the difference!

The plain Admiralty tube (*top*) failed – from local dezincification, one of the most prevalent types of corrosion encountered in the power and marine fields. The Chase *Antimonial Admiralty* tube is still in good condition.

Millions of pounds of this Chase alloy for condenser tubes have been installed in the last nine years, and not a single service failure due to dezincification has been reported.

This is something for power engineers to ponder, especially since Antimonial Admiralty tubes may be had at *no increase in cost.*

For full information, phone your nearest Chase Warehouse or Service Office.

CHASE

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY at HOUSTON LOS ANGELES NEW ORLEANS SAN FRANCISCO TULSA

CHASE BRASS & COPPER CO.

—Incorporated—
Waterbury 91, Connecticut
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON INDIANAPOLIS† KANSAS CITY, MO.† LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON†

† Indicates Sales Office Only

This is the Chase Network—handiest way to buy brass

ROTO Tube Cleaners

Especially handy inside drums and other tight spots

ROTO
Air Valve

With a Roto Tube Cleaner your operator doesn't have to worry about a helper to turn air on and off. The operator himself controls the entire operation with an air valve located directly behind the motor. You will appreciate the benefits of one-man control because it provides safer, more efficient tube cleaner operation, especially inside drums and other tight spots. Write for details.

Roto Division of Elliott Company
145 Sussex Avenue, Newark 1, N. J.

EXTRA STRENGTH FOR HEAVY DUTY

KEWANEE

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Steel Plus Rivets

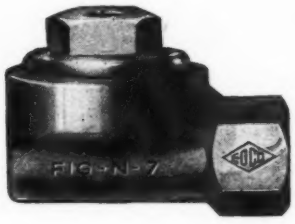
Steel plus Rivets further strengthened by extra stout stays and braces. Embodies all characteristics which make firebox type boilers especially adapted for high pressure.... 4 to 304 H. P. 100, 125, 150 lbs. W. P.

75 Years
Boilermakers

Write Department 96-K5 for 6" scale with pipe diameter marking.

EDCO

SPRAY NOZZLES



for RE-COOLING AND AIR CONDITIONING

Any industrial atomizing —cooling—or washing operations that call for spray nozzles can be done *better* with Edco.

Here's why: every EDCO tip is carefully designed and checked for spray angle, atomization and actual rated capacity — goes through rigid inspection before the EDCO diamond is stamped on it.

EDCO *is furnished in*

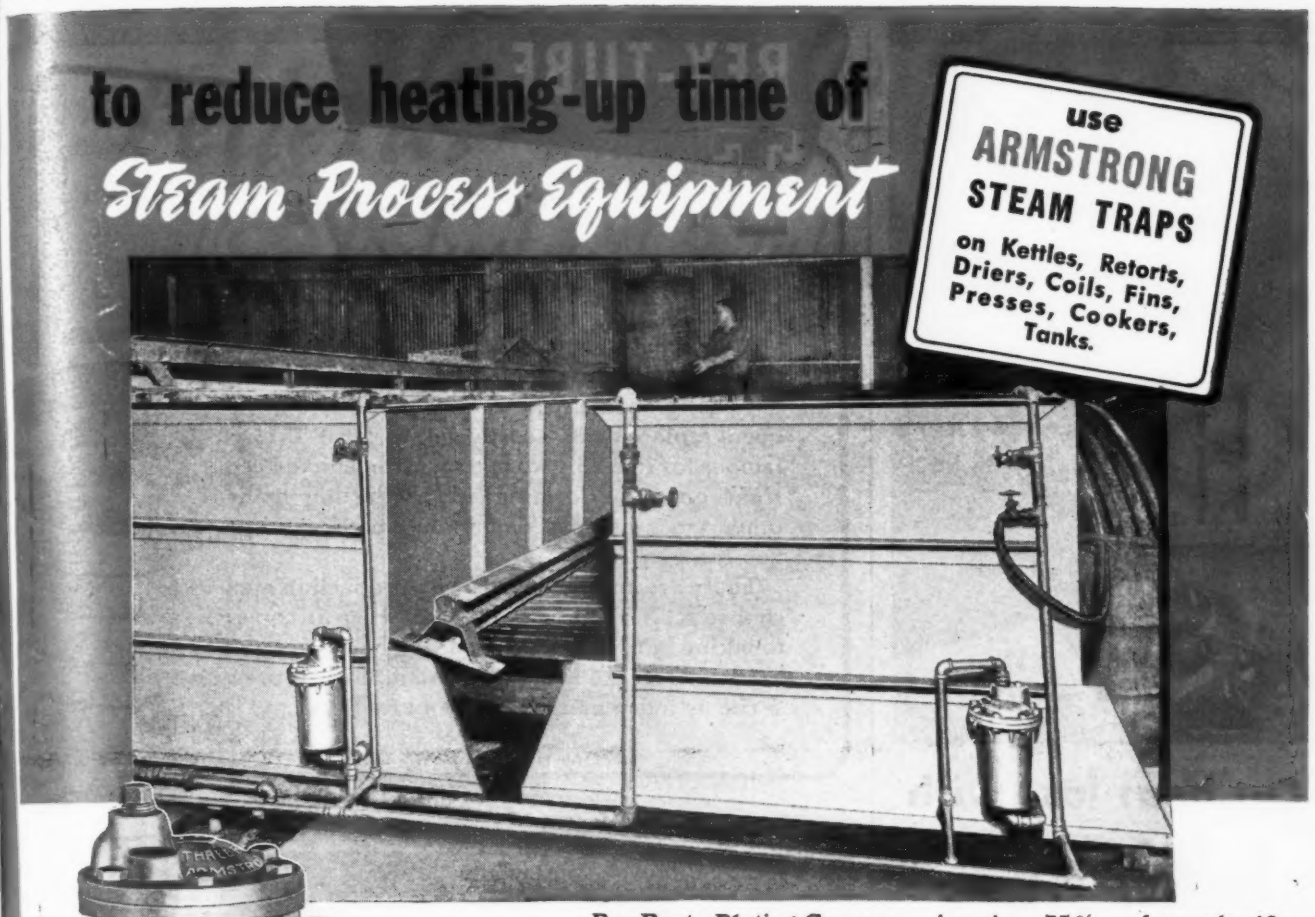
STAINLESS STEEL
BRONZE
NITRALLOY
MONEL
STONEWARE
HARD RUBBER

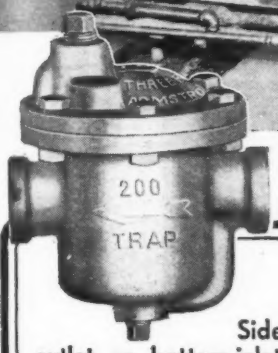
For savings offered by EDCO write at once for Booklet 3C1.

EDDINGTON METAL SPECIALTY CO.
P. O. Box K Eddington, Pa.

to reduce heating-up time of *Steam Process Equipment*

use ARMSTRONG STEAM TRAPS on Kettles, Retorts, Driers, Coils, Fins, Presses, Cookers, Tanks.





Side-inlet side-outlet or bottom-inlet top-outlet traps for pressures to 250 lbs. Stainless steel bucket and lever assembly. Chrome steel valve and seat—hardened ground and lapped. Automatic air elimination. No steam leakage. No clogging or sticking.

Ask for 36 page STEAM TRAP BOOK. Complete data in capacities, prices, selection, installation, maintenance, trouble-shooting and other factors of value in connection with condensate drainage. Free on request.

Bar Rusto Plating Corporation, Kansas City, Mo., credits the Armstrong Traps in the above illustration with increasing their production, providing more uniform temperatures and reducing coal consumption.

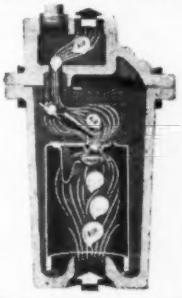
Elliott Packing Company reduced cooking time from 8 hours down to 3½ after installing Armstrong Traps.

California Packing Corp., Honolulu, brought kettles from 80°F to 200°F in four minutes with Armstrongs.

Gustafson Oil Company, Chicago, heats tank cars in 3½ hours with Armstrong Trap—formerly required 5½ hours.

Soybean Products Company, Chicago, reduced cooking time 75% — formerly 40 minutes, now 10, thanks to Armstrong Traps on steam kettles.

Blast Trap for "Up and Down" Process Units



Auxiliary thermic vent illustrated below opens wide to exhaust huge amounts of air. Closes tight when air is exhausted and steam enters trap.

There is an Armstrong representative near you. Write today for complete information. ARMSTRONG MACHINE WORKS, Maple St., Three Rivers, Mich.

ARMSTRONG STEAM TRAPS *for* **POWER PROCESS HEATING**

Cut heat loss with

RANAREX*

LET Ranarex* show you how to cut heat loss as much as 20%. Install this CO_2 indicator and recorder and measure the CO_2 in flue gas. Then regulate combustion until the percentage is at precisely the point determined to be correct for your load. This gives you the last bit of power possible from the fuel you burn.

The Ranarex instrument is rugged because it contains no chemicals or fragile parts. Yet it is so sensitive that it gives almost instant readings within 3/10 of 1% accurate. It requires no skill to operate it.

GET FREE BOOKLET

Take this first step toward fuel conservation today. Write for free booklet to The Permutit Company, Dept. A, 330 West 42nd Street, New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.

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product of

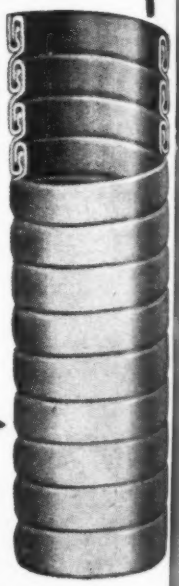
PERMUTIT

REX-TUBE

Top choice for tough jobs!

● Put REX-TUBE type RT-15 on your tough, hard-to-handle connection problems. Then watch what happens when this rugged, high-quality flexible metal hose takes charge of the heavy-duty assignments! You can forget all about frequent replacements—costly delays. For RT-15 is famous for its ability to take punishment; to keep right on outperforming and outlasting many other types of hose under the roughest usage you can give it.

There are ample reasons why production men choose REX-TUBE type RT-15 when it comes to taking hard knocks. Illustrated below are just a few of RT-15's many outstanding features. Write us today and ask for Booklet E-144.



REX-TUBE (RT-15)—is strong and well-constructed to take years of wear and tear. Made from heavy strip, steel or bronze. Interlocked design, with inner packing of high-grade asbestos.

REX-TUBE (RT-15)—is widely used for handling steam at low and moderate pressures, for unloading and loading tankers and barges, steaming out tank cars, and other "hot" process jobs.

REX-TUBE—is part of the big, complete C.M.H. family of Flexible Metal Hose. RT-15 is only one type in the REX-TUBE line. There are other REX-TUBE types, in various sizes, with soldered or packed-on couplings, to meet practically any industrial requirement.

Flexible Metal Hose for Every Industrial Use

CMH CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

Federal ANNOUNCES ITS *Industrial Tube Policy*

BECAUSE of the totally different and unusually severe operating conditions that have to be met by power tubes used in industrial heating equipment

—in installation and maintenance by personnel unfamiliar with vacuum tubes,

—under operating conditions involving extreme variations in load during processing and between operations... the shocks, jars, vibration due to nearby presses, punches, drilling machines,

Federal ANNOUNCES ITS *Industrial Tube Policy*

ALL Federal Industrial Tubes . . .

¶ will be specifically proportioned for industrial use.

¶ will have *ample* factors of safety for long life and economy under the severe operating conditions met in industrial service.

¶ will be of *rugged mechanical design* to meet the requirements of industrial installation and operation.

¶ will carry a *full guarantee* against defective materials and workmanship for 18 months after date of shipment, *or 2000 hours* effective life*, whichever occurs first, when operated under rated conditions, as against the *1000 hours* effective life* rating, the common practice in rating ordinary tubes.

Federal recognizes that in many industrial applications tubes will be operated with filament power only, for a considerable portion of the time. For this reason effective tube life will be computed as the sum of the hours with filament and plate power applied, and 20% of the hours with only filament power applied.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

WF-1283

ELIMINATE CONSTRICTION *in* PIPE FLOW *with the* WESTPORT WELDED JOINT . . .

Yes, you eliminate constriction in pipe flow with the Westport Welded Joint because reduction in inside diameter at the root of the weld NEVER EXCEEDS the inside diameter of the pipe, if furnished to the smallest internal diameter permitted under standard commercial tolerances!

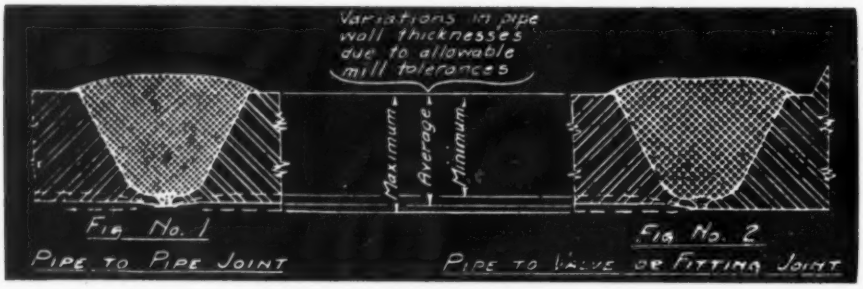
Specifically, the Westport Welded Joint allows complete penetration to the root of the weld . . . smooth pipe contour at the base of the weld MINUS any "icicles" or "protrusions" . . . greater flexibility in alignment of pipe, valves and fittings. You will profit by using Westport.

ENGINEERS' NOTE

DO YOU HAVE ANY PIPING PROBLEMS WE MIGHT BE ABLE TO HELP SOLVE All types of prefabricated piping jobs are today being done by W. K. Mitchell Co. Years of piping research and experience has taught us the solution to piping troubles. If we can be of help, please call on us. Our Engineers are always at your service.

WRITE FOR INFORMATIVE BULLETIN AND LATEST DATA.

1899 — 1945



Illustrated here is the Westport Method . . . consisting of the use of a joint in which the ends to be welded are formed and machined to provide a special U-shaped groove . . . joining the lips at the root of the weld by the oxyacetylene process . . . and completing the joint by the usual electric arc procedure.

W. K. MITCHELL & CO., INC., Philadelphia 46, Pa.

Meet the Labor Shortage with a Sauerman ONE-MAN SYSTEM *for Stockpiling Coal!*

New England power plant, receiving all its coal by water, stores surplus ship-loads by means of small Sauerman Scraper System installed on dock alongside plant. When coal is needed from stockpile, the scraper reclaims to hopper feeding conveyor that runs to boiler-room bunkers.

ONE MAN does the job! Efficiently and completely. At hundreds of plants, large and small, SAUERMAN Power Drag Scrapers are storing and reclaiming coal at cost of only a few cents per ton.

It's easy! Operator may be in cab at edge of storage area, or anywhere nearby, operating scraper by remote control at finger tip.

Sauerman equipment can be used with any scheme of unloading. Coal delivered at any point in area. Scraper does the rest. Forms pile in compact layers. No wasted space. No air pockets in coal pile to cause spontaneous combustion.

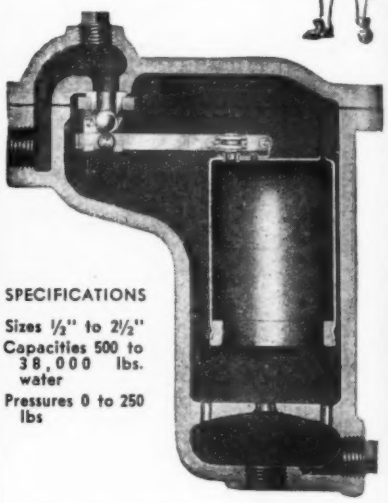
SEND FOR SAUERMAN ENGINEERING CATALOG

See for yourself how Sauerman System saves manpower—saves coal—eliminates excessive dust—makes coal pile *safe—at low cost.* A profitable investment. Wire or write

SAUERMAN BROS., Inc.

562 S. CLINTON ST., CHICAGO 7, ILL.

CRYER USERS are CRYER BOOSTERS "All's Well with CRYER TRAPS"



SPECIFICATIONS

Sizes ½" to 2½"
Capacities 500 to 38,000 lbs. water
Pressures 0 to 250 lbs

If you're interested in eliminating troublesome maintenance of steam lines . . . if your traps stick or don't vent properly . . . give heed to what Cryer Trap users have to say from actual experience over a long period of time and under a wide range of conditions:

- **. . . "the Cryer really operates . . . 100% satisfactory"**
- **. . . "performance entirely satisfactory . . . there has never been any sticking . . . no occasion to clean Cryers in five years"**
- **. . . "they stand up under most any conditions and need very little care."**

Incidentally, users have stated that their experience with Cryer Traps agrees with our claims as set forth in Cryer advertising in "Power".

If man-power shortage is a problem in your plant, you'll welcome Cryer Traps because they require so little attention and are so outstandingly care-free in performance. Get all details NOW.

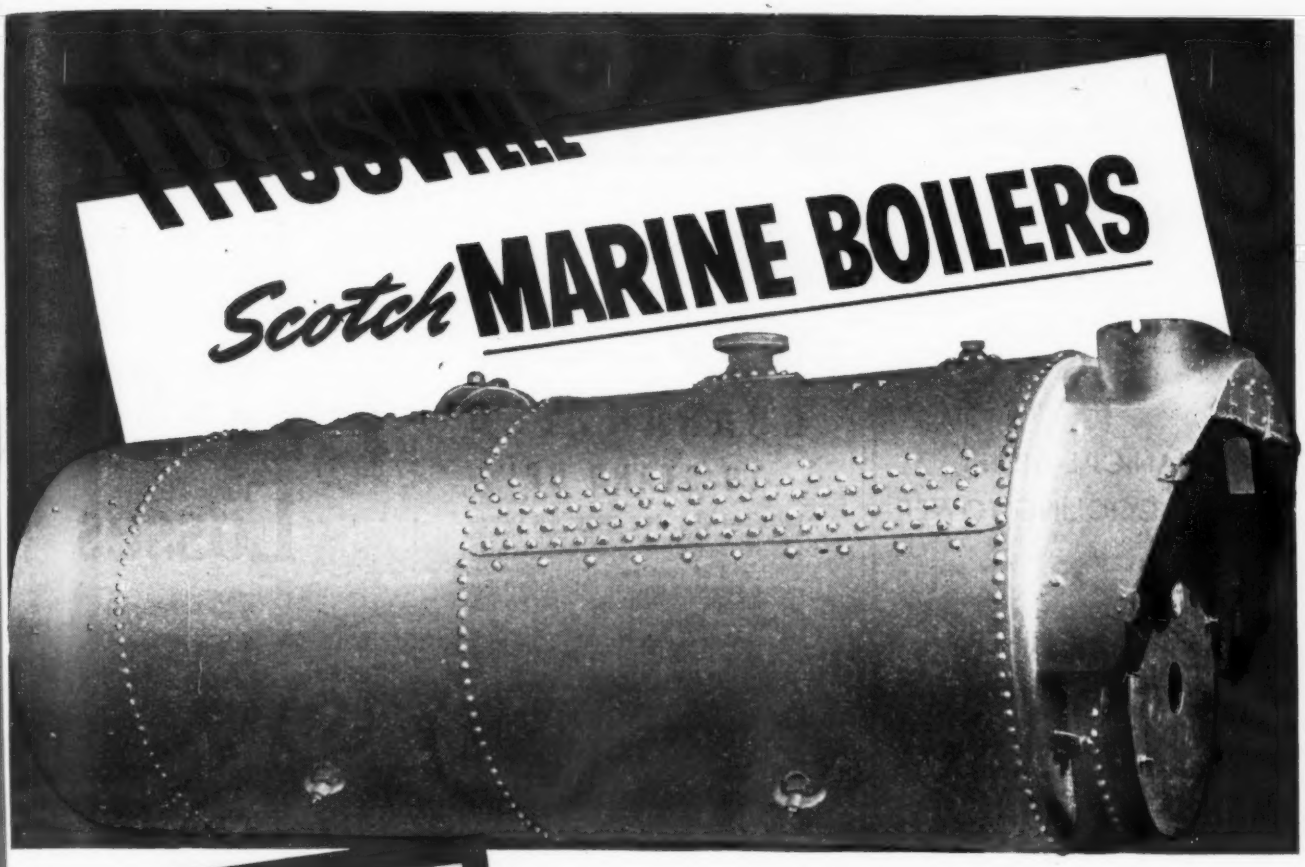
We carry all sizes of traps and spare parts for the line formerly known as the J-M Ball Steam Trap.

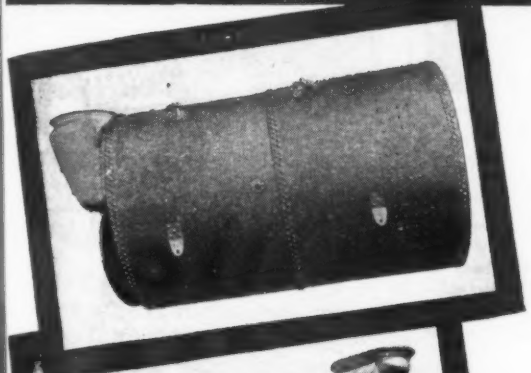
CRYER TRAP & VALVE CO.

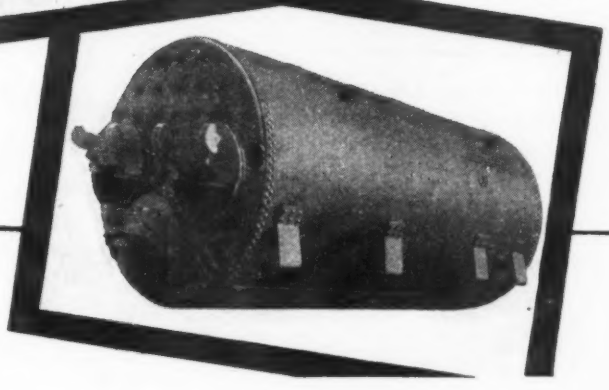
366 Madison Ave., New York, N. Y.

Manufacturers of steam specialties for over 45 years.

TITUSVILLE
Scotch MARINE BOILERS







many types... sizes for every steam or power need

Because of their initial low cost, versatility, efficiency and economical operation—TITUSVILLE Scotch Marine Power Boilers are chosen for hundreds of industrial and marine applications where constant, uninterrupted power and steam supply are necessary.

Call on Titusville for *application-engineered* suggestions in designing and building the type of Boiler best fitted for your specific needs.

THE TITUSVILLE IRON WORKS COMPANY

Division of Struthers Wells Corporation
TITUSVILLE, PENNSYLVANIA
Offices in Principal Cities

C. H. WHEELER OF PHILADELPHIA

STEAM CONDENSERS

•

AIR EJECTORS

•

MECHANICAL DRAFT COOLING TOWER

•

DECK MACHINERY

C. H. WHEELER MANUFACTURING Co.

19th St. & Lehigh Ave.

Philadelphia 32, Pa.

HERCULES

Seamless Copper

FLOATS

GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

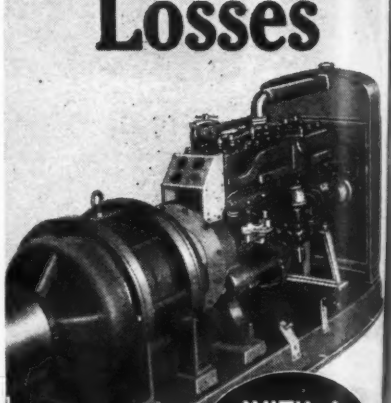
Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS

200 Franklin St.

SPRINGFIELD, MASS.

Insure Against POWER FAILURE Losses



WITH A **U. S.** STAND-BY ELECTRIC PLANT

It is wise to safeguard electric ovens, furnaces, electrolytic processes and other crucial operations with stand-by service to avoid losses of power failure.

We specialize in the building of this type of Emergency Electric Plant equipment and have successful installations in varied applications throughout the nation. Write for specific details.

UNITED STATES MOTORS CORP.
552 Nebraska St. Oshkosh, Wis.

The U. S. line includes Gasoline and Diesel Units up to 75 KW

U.S. ELECTRIC PLANTS

FOR STAND-BY SERVICE

U.S.

1918—1945...

Your boy and my boy . . . it's hard to realize they're grown men . . . out there fighting—proving themselves worthy sons of the 1918 doughboys of St. Mihiel and Belleau Wood . . . the Argonne forest. Taking up where we left off—they'll *finish* the job this time.

The first FREDERICK stokers left our shops in that same year . . . 1918. Contributing to the comforts of the frivolous '20's, helping to save fuel in the troublous '30's . . . today the *improved* FREDERICK stoker aids in the conservation of precious man hours due to its

Fully active grate surface . . .
Continuous speed type transmission . . .
Completely enclosed windboxes and mechanism.

Send for our Stoker catalog. It presents additional reasons why you should buy the sturdy FREDERICK stoker.

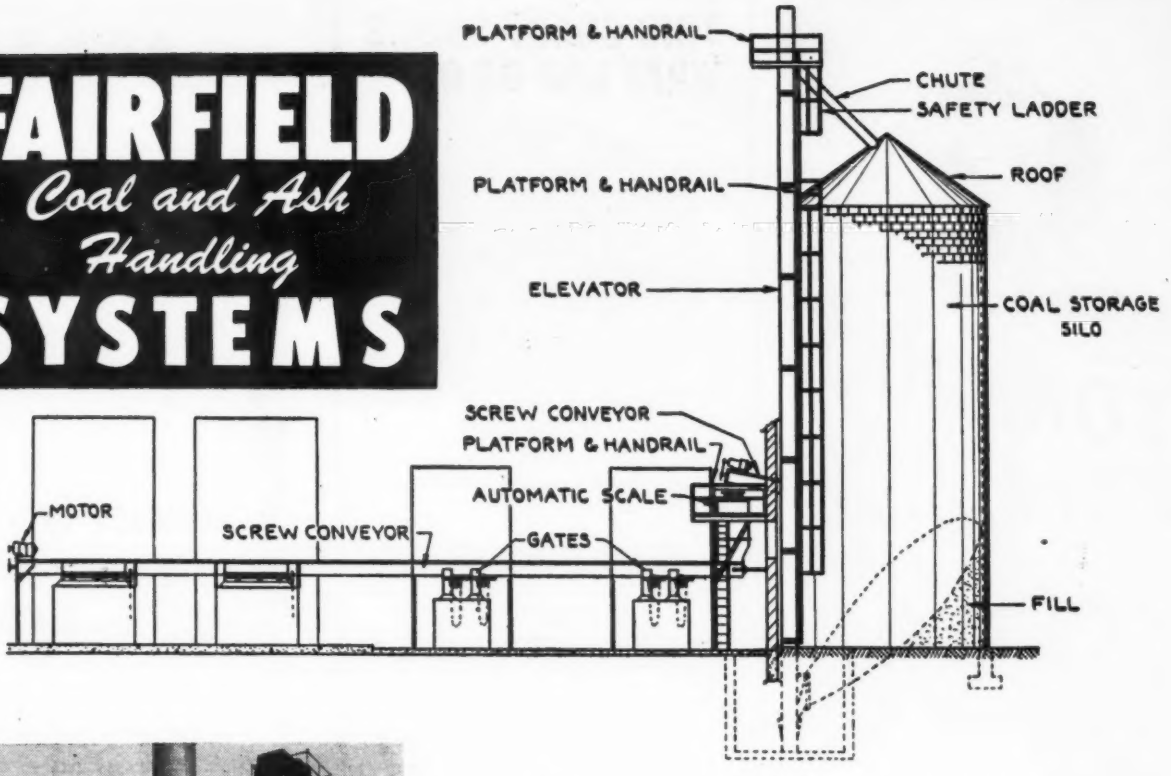
Hopper or Bin Feed. 200 to 850 lb. per hour. Clinker or Side Dumping Grate.

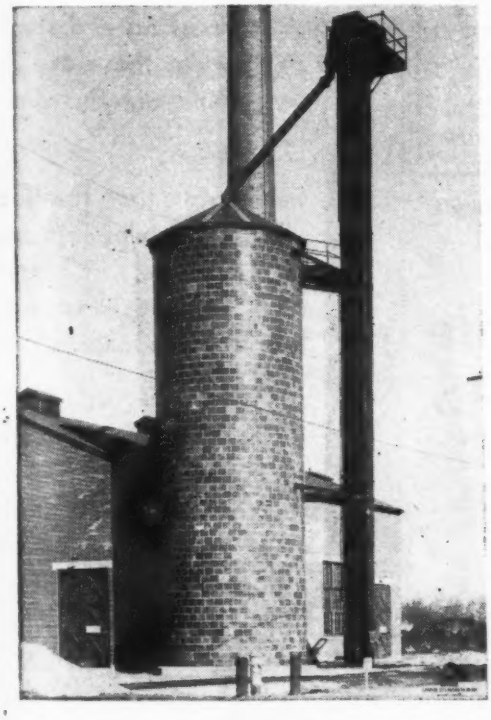
FREDERICK *also* manufactures fine Centrifugal Pumps designed and guaranteed to do the job for which they are sold. Details upon request . . . no obligation.

THE *Frederick* IRON & STEEL CO.
Frederick, Maryland

STOKER SPECIALISTS SINCE 1918

FAIRFIELD
Coal and Ash Handling SYSTEMS





Every installation is designed to fit your particular need

• Illustrated is a typical Fairfield coal handling system showing how the coal is handled automatically from car to storage Silo to stoker or pulverizer.

The Fairfield Silo is built of vitrified glazed tile — does not absorb moisture — air channels provide effective insulation—location outside the power plant eliminates dirt and dust from boiler room—takes up minimum space.

The system provides a choice of methods for handling coal from storage to stoker or pulverizer. The two most common are the screw conveyor, as illustrated bottom left, or a weigh larry.

The Fairfield system often includes complete ash handling equipment and silo for storage.

If you anticipate conversion to coal, addition to your present plant, or erection of a new plant, consult a Fairfield Engineer for dependable, efficient, low cost coal and ash handling. Catalog upon request.

THE FAIRFIELD ENGINEERING CO.

Builders of Coal and Ash Handling Equipment

320 CHICAGO AVENUE • • • MARION, OHIO

TORNADO

PORTABLE INDUSTRIAL VACUUM CLEANER

reduces **DUST DANGER**

QUICKLY cleans walls, floors, line shafting, pipes, overhead beams, etc. Reduces health and fire hazards. Improves working conditions and morale. Cuts waste. Salvages valuable scrap. Increases efficiency.

A real one-man unit. Weighs only 40 lbs. 1 H.P. Universal motor. 49" waterlift, 175 c.f.m. Removes dust, chips, lint, etc. Does a thorough cleaning job. Attachments for cleaning everything.

Convertible into Blower for blowing dust and dirt out of motors, generators and hard-to-reach places. Adaptable for spraying paint and insecticide.

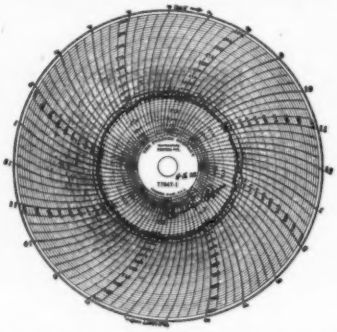
Free Trial—Write to

BREUER ELECTRIC MFG. CO.
5114 N. Ravenswood Ave., Chicago 40

TAKE THE DUST OUT OF DUSTRY

TORNADO

THIS CHART SHOWS WHAT CAN BE DONE



. . . by putting high pressure condensate back into the boiler without loss of heat or water

The **Sterling** *System*

DOES IT!

No cooling or heat loss in condensate with Sterling. Hence more Btu's, more effective work out of every pound of fuel.

The savings in fuel and water pay for the installation in short order.

STERLING ENG. & MFG. CORP.
Templeton Manfg. Co.
110 Business St.
Hyde Park 36, Massachusetts

XZIT

Cleans from fire-box to top of stack

Removes fire-scale and soot while boilers operate

Why tolerate fire-scale, soot, sparking and stack fires, when these are so easily and quickly eliminated with Xzit?

Fed into the fire-box while the boiler remains in operation, Xzit chemically removes soot and loosens fire-scale so it drops off.

By keeping heating surfaces clean from fire-box to top of stack, Xzit gives you increased fuel efficiency, reduces blowings, and keeps equipment on the line longer. Xzit eliminates sparking and puts out stack fires instantly.

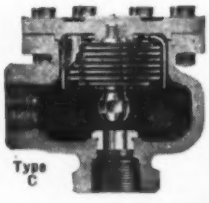
Our service engineer will gladly demonstrate Xzit in your plant. Write.

XZIT SALES CO
1031 Clinton St., Hoboken, N.J

NICHOLSON *makes a Complete Line of Dependable Long-Life* STEAM TRAPS

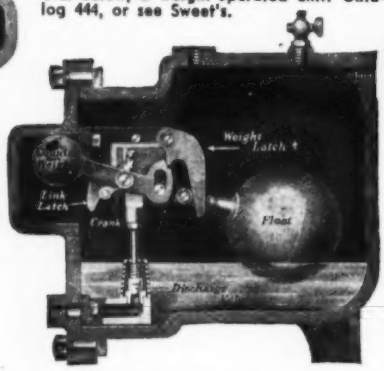
AND

CYLINDER CONTROL VALVES



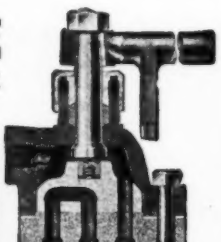
Type C

Nicholson Heavy-Duty Traps are made in types for all pressures and every power and process purpose: weight-operated piston-operated, steam, compressed air, etc. Below, a weight-operated unit. Catalog 444, or see Sweet's.



Nicholson Industrial Thermostatic Steam Traps (Type C above) show, in plant tests, substantially greater drainage capacity than any units in their price range. 5 types; ¼" to 2". Bulletin 544.

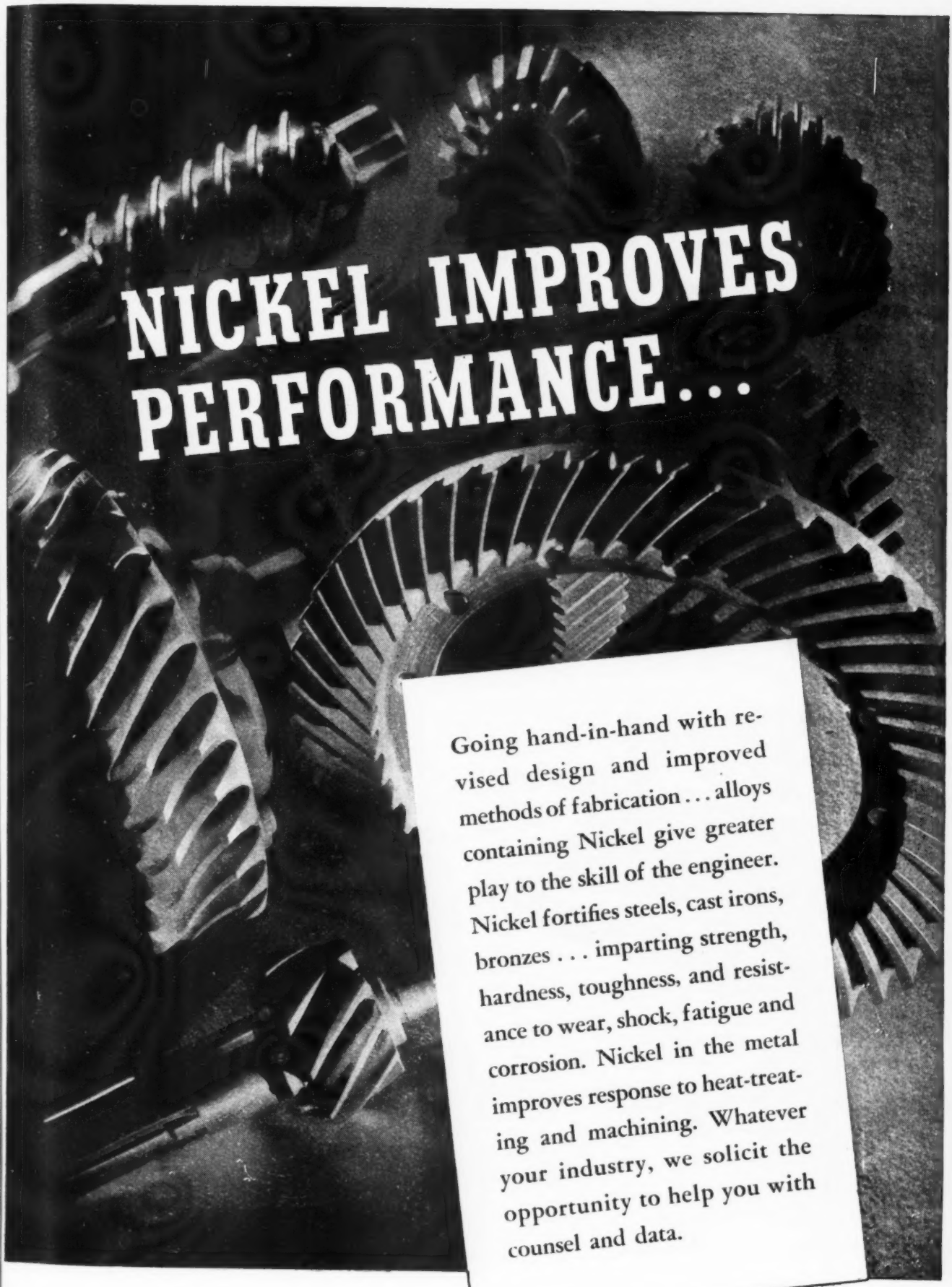
★



Nicholson Cylinder Control Valves (above); standard types for many applications. For air, steam, oil, gas, tar or water. Also lever, foot, solenoid and motor-operated types. Catalog 543.

W. H. NICHOLSON & CO.
125 OREGON ST.
WILKES-BARRE, PA.

Valves • Traps • Steam Specialties



Going hand-in-hand with revised design and improved methods of fabrication . . . alloys containing Nickel give greater play to the skill of the engineer. Nickel fortifies steels, cast irons, bronzes . . . imparting strength, hardness, toughness, and resistance to wear, shock, fatigue and corrosion. Nickel in the metal improves response to heat-treating and machining. Whatever your industry, we solicit the opportunity to help you with counsel and data.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

"Why shouldn't I leave the floor?

These boilers have Hagan Control!"

When the Hagan engineer and a prospective customer came into the boiler room, there wasn't an operator in sight.

Yet, all five boilers were on the line, generating over a million pounds of steam an hour. They were burning blast furnace gas, automatically supplemented by pulverized coal, and supplying power for the entire mill. Signal lights flashed on and off, indicating the operation of burners . . . fans speeded up and slowed down in accordance with load variations . . . flow meters indicated that the boilers were handling a widely fluctuating load.

Finally, in a corner partitioned off as an office, the visitors found one man eating his lunch and reading a newspaper. The visiting engineer expressed his astonishment at the sight of all this intense activity without at least half a dozen operators in attendance.

But the man in charge was unperturbed. "Why shouldn't I leave the floor?" he said, "These boilers have Hagan Control."

This complete confidence in Hagan Control is characteristic of men who use it. To them it is a dependable tool. They use it with the confident familiarity that a good mechanic feels for his favorite wrench or screwdriver.

Write for full information.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

The nearer we get the

Each stepping stone to Tokyo has been harder to take.

They said it couldn't come any worse than Guadalcanal. That even the nights were something you'd rather forget. Japs shrieking in the dark and rapping on trees and tossing rocks into foxholes—and now and then a grenade just to keep the boys guessing.

Then came Tarawa.

You heard how the landing boats got hung on a reef. How the boys had to wade in under cross-fire from the enemy. They said Tarawa would go down as the worst.

Then came Iwo Jima.

They said, a mile offshore, in the barges, the sea boiled like vegetable soup from Jap shelling. It was full of chopped-up boats. They said the Japs' big guns were above and they just aimed down hill and let go. They said it cost us five times the price of Tarawa. They said Iwo was the worst.

Next?

Let's make 7 unlucky

e harder they fall !

Well—there's Chichi Jima, Haha Jima—fifteen islands to go. And then, of course, the ultimate objective—Japan itself.

You can help lower the price we'll have to pay —by buying War Bonds. Bonds to give our boys equipment to throw at the enemy. For the more *equipment* they can throw at them, the fewer *lives* they will have to give.

How much are *you* investing to help preserve American lives?

y for the Japs!

7th War Loan

Contributed by

Diesel Engine Division of American Locomotive Company

The boiler operators were willing to learn

A small paper mill replaced several old hand-fired boilers with a new 145 psi. boiler, operated at 250% rating continuously.

Trouble started within two months, partly because the salesman of water softening equipment advised that no after-treatment of phosphate was necessary. Considerable carryover was experienced during the whole period, then tubes in the front water wall burned out.

A check revealed that the operators of the old plant, who were still on the job, had made little effort to maintain proper boiler water conditions. No one had tried to show them how.

Hall engineers were given a free hand to teach the personnel or to recommend changes if they seemed necessary to make sure that proper conditions were maintained. They chose the former co ırse, and a Hall engineer practically lived at the plant for the next few weeks. Patiently he taught the "oldtimers" why water-conditioning was necessary, showed them what to do and how to do it, made them proud of their job. They cooperated loyally.

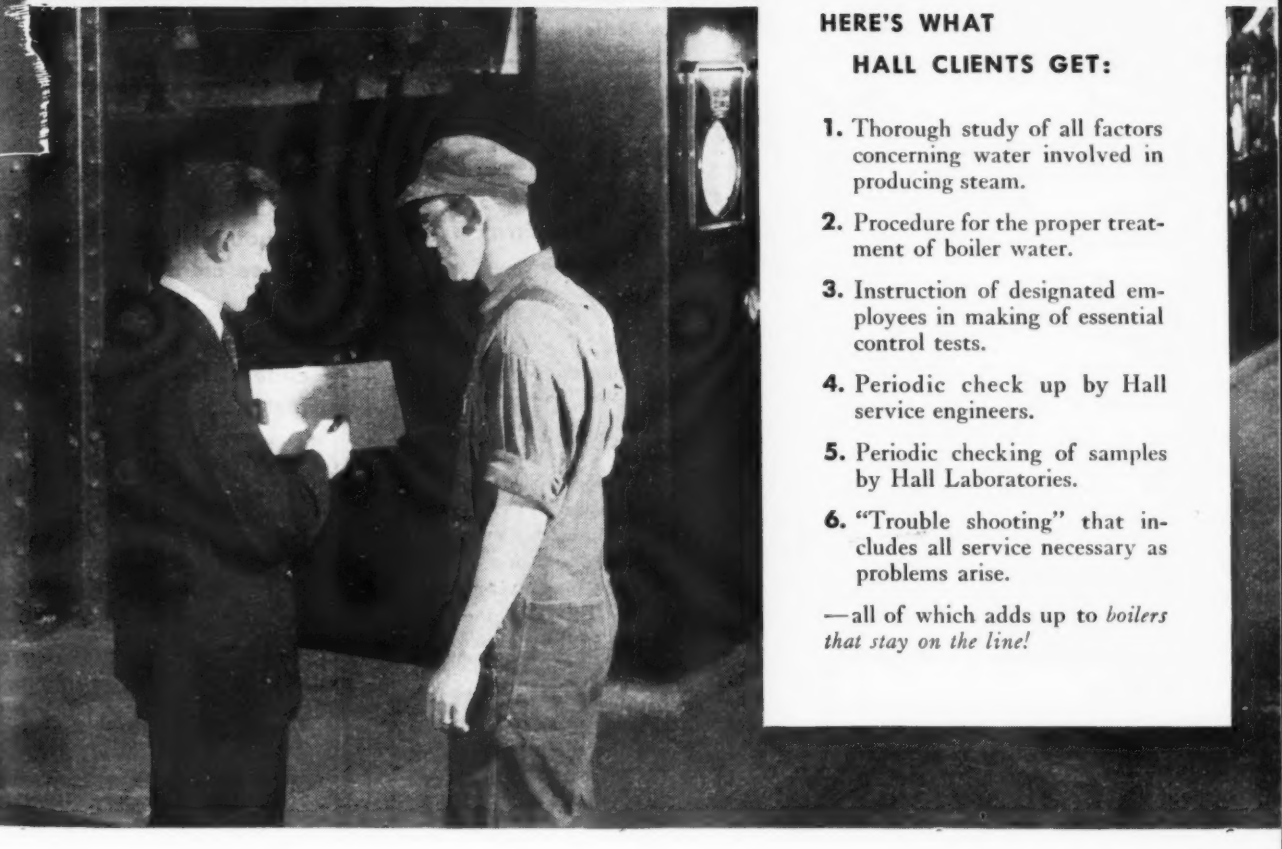
The result shows up in the report of a Hall service engineer, more than a year later, "No evidence of corrosion or hard scale formation. Fair amount of sludge in rear section, but washed out easily. Boiler has not been cleaned for one year, but superintendent stated that present condition was comparable to that of year ago."

This is just one more example of the fact that Hall service and Hall responsibility go far beyond prescribing chemicals to be added to the boiler water. Small plants as well as large need help and it is the job of the Hall service engineer to provide the right kind of assistance to maintain peak boiler performance.

Every plant that generates its own steam power can profitably use Hall service. Write us for full information.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
CALGON



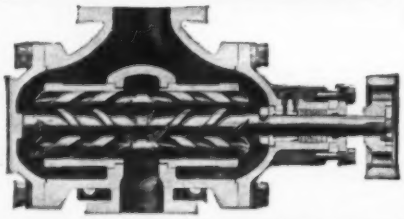
HERE'S WHAT HALL CLIENTS GET:

1. Thorough study of all factors concerning water involved in producing steam.
2. Procedure for the proper treatment of boiler water.
3. Instruction of designated employees in making of essential control tests.
4. Periodic check up by Hall service engineers.
5. Periodic checking of samples by Hall Laboratories.
6. "Trouble shooting" that includes all service necessary as problems arise.

—all of which adds up to *boilers that stay on the line!*

HALL SYSTEM *of Boiler Water Conditioning*

IMO

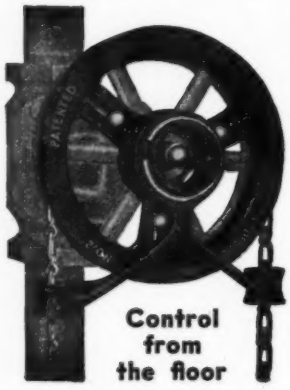


THE PUMP *without* PULSATION

The steady, uniform flow produced by the continuous turning of the rotors in an IMO pump is ideal for oil burners, hydraulic and other service requiring an even, pulsation-free flow.

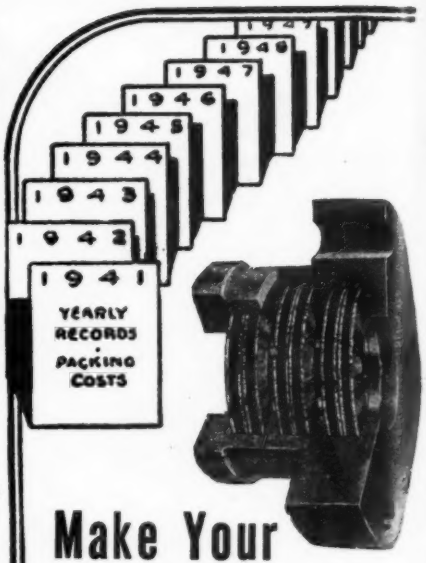
IMO
PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

Make Your Overhead Valves SAFE And Easy to Reach---



With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.



Make Your Next Packing Job *L-A-S-T!*

During these days of increased production, it is especially annoying and costly to experience shutdowns due to packing trouble.

There is a solution. Install France "Full-floating" Metal Packing in your engines, pumps and compressors. The result is increased efficiency. And each job lasts for years without maintenance expense. Saves money, too, in the long run.

Installation is a simple procedure. See that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C. Write for details and Folder M-7. Make your next packing job L-A-S-T!

Original FRANCE
Sold on approval
Satisfaction Guaranteed

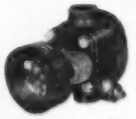
THE FRANCE PACKING COMPANY
Tacony Philadelphia 35 Penna.
Mid-Continent Representative:
Mr. J. M. FULLER, 3725 West 7th St.
FORT WORTH, TEXAS

Original FRANCE METAL PACKING

WHAT THE HEART IS TO LIFE
THE SWITCH IS TO A CONTROL
Either Case, When One Fails All Else Ceases To Function

TEMPERATURE AND PRESSURE CONTROLS

EXPLOSION PROOF CONTROL



LIQUID LEVEL CONTROLS

As long as the blood stream is permitted to flow through the heart, the human machine goes on, fulfilling its destiny. Likewise, as long as the electrical current is permitted to flow through the switch the control fulfils its designed purpose in whatever automatic heating or industrial application it may be used with.

The relative importance of a switch is sometimes overlooked, especially in an automatic control. In the event of a switch failure, as in the case of a boiler pressure or temperature limit control, as well as other important applications, the failure may prove hazardous and costly. That is why from the very beginning, Mercoid Automatic Controls were equipped exclusively with the now famous hermetically sealed Mercoid mercury switches, known and used the world over. They provide an electrical contact designed for millions of perfect operations—one reason why Mercoid Controls are noted for their long life and better performance. Mercoid switches are immune to dust, dirt, moisture or corrosion. They are not subject to open arcing, pitting or sticking of the contacting surfaces. That is the reason why Mercoid Controls are following the Army in some of the far outposts where adverse and extreme humid weather conditions exist.

There are many other important features incorporated in Mercoid Controls, but in the meantime, remember the all-important Mercoid Switch—the unfailing heart of Mercoid Controls.

THE MERCOID CORPORATION, 4221 BELMONT AVENUE, CHICAGO 41, ILLINOIS

MERCOID DA CONTROLS
FOR THOSE TEMPERATURE OR PRESSURE CONTROL PROBLEMS

FOSTER REGULATION ENGINEERING*

MEANS THE RIGHT VALVE FOR LONG LIFE AND EASY MAINTENANCE

FOSTER REGULATION ENGINEERING applies to valves of all types and capacities. Here's a small one, Type 39-Y3 for close regulation of small volumes of steam, air, water or oils. It is one of several Foster Y-types.

OPERATING FEATURES

Easier action because of exceptionally long, large diameter spring.

Pressure equalizes faster because the snubbing action of finger-type springs prevents overtravel of the disc.

Full effective area of the diaphragm is maintained through use of properly proportioned jamb nut.

Only small changes in reduced pressure are needed to overcome inlet pressure at orifice. Ratio of diaphragm area to orifice area is 150 to 1.

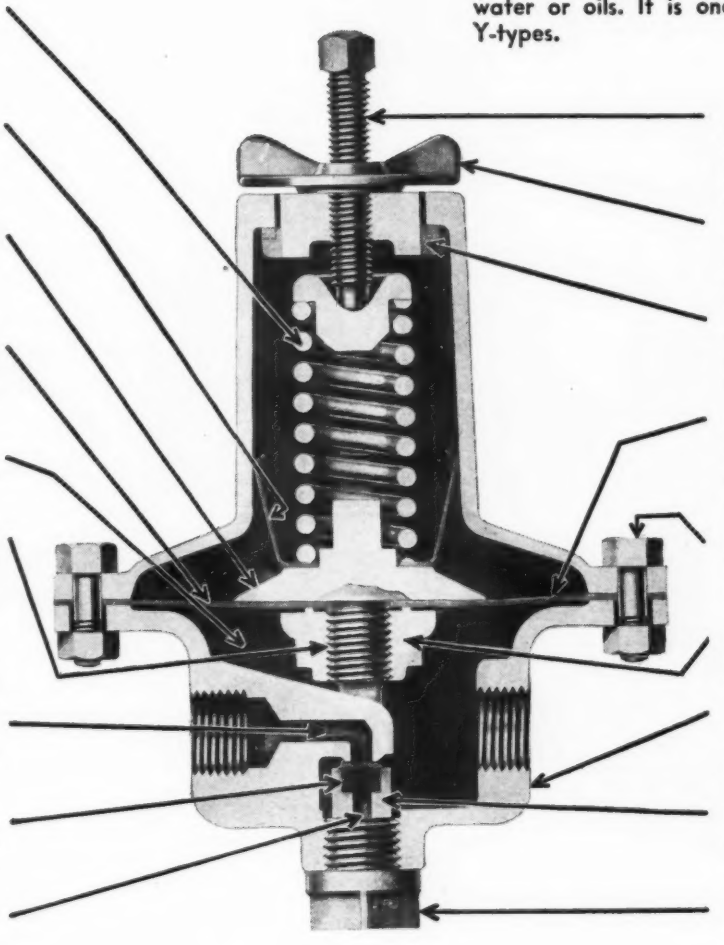
Regulation is closer because large chamber permits complete expansion.

High diaphragm pressures do not affect thread structure or joint tightness because of large diameter, rigid load screw.

Full satisfaction of downstream demand up to the capacity of the valve is obtained because of large area, smooth entrance port, assuring full inlet pressure at orifice seat.

Grit particles are absorbed by soft disc preventing damage to seat.

Disc always returns to same seating indenture because of guide pin.



MAINTENANCE FEATURES

Close adjustment of reduced pressure is easy because adjusting spring is long, with fine thread.

Once set, locknut assures constant compression of spring, regardless of line vibration.

Quick inspection or spring replacement because of removable bayonet-type head.

Diaphragm assembly with jamb nuts, yoke and disc can be removed as a unit for inspection without breaking center joint.

Quick dismantling at main joint because of easily replaced, standard bolts and nuts.

Diaphragm can be readily inspected or replaced. Yoke unscrews at center thread.

Sediment and scale can be removed without special tools because of open type body.

Hole provided in yoke makes it easy to drive out worn disc.

Seat may be inspected or resurfaced through bottom plug opening.

***FOSTER REGULATION ENGINEERING MEANS**

(1) Intelligent understanding of the operator's problems.
(2) Thorough knowledge of performance characteristics necessary for selection of the right valve for the application.
(3) Sixty-six year's experience in design and manufacture of practical valves.

★ SPEED THE DAY ★
BUY MORE WAR BONDS

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

106 MONROE STREET • NEWARK 1, N. J.

5-FE-1

For the Safety of SHIPS...

America needed ships . . . 50,000,000 tons of cargo, tanker and transport ships, in addition to a vast fleet of Naval vessels—*and all of these ships needed safety valves, relief valves, and pressure gauges!*

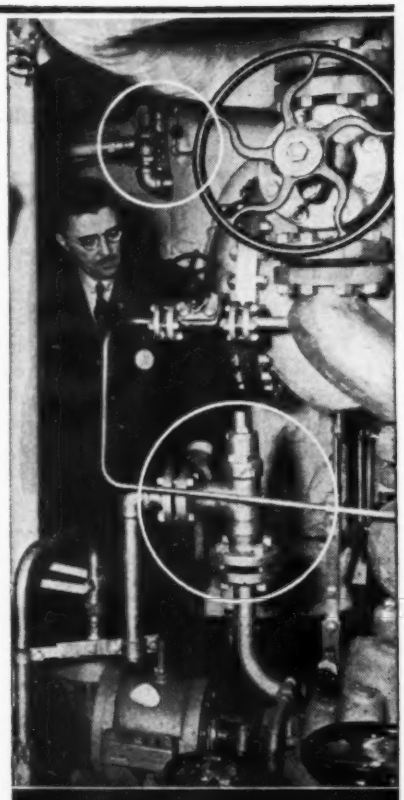
Where did all these valves and gauges come from? Lonergan produced a lot of them . . . thousands of tons of them . . . and did so in addition to serving many of America's other vital war industries.

The facilities and 73 years of "know-how" that made possible this production achievement are at your service whenever you need *Safety Valves, Relief Valves,* or *Pressure Gauges.* Get Lonergan recommendations on your next inquiry.

J. E. LONERGAN COMPANY, 2d & Race St., Phila. 6, Pa.

Lonergan

Safety Valves • Relief Valves • Pressure Gauges
SINCE 1872 — Makers of Pressure-Safety Appliances for the Power, Mechanical, and Process Industries



TWO OF MANY TYPES OF LONERGAN RELIEF VALVES USED ON SHIPS

OFFICIAL U. S. NAVY PHOTO

Every wire, every strand, is PREformed to the exact shape it takes in the rope. This relieves internal stress—makes the rope more flexible.

Specially Designed for Elevators

Macwhyte PREformed Elevator Ropes are made from tough, flexible wire found by years of experience to be best for elevator service. The correct lay and combination of wires are used to keep stretch at a minimum, yet make the ropes as flexible as possible to withstand bending fatigue. Flexibility is further improved by Macwhyte Internal Lubrication, which keeps individual wires and strands free to move as they bend around sheaves and drums.

MACWHYTE COMPANY
2944 Fourteenth Ave., Kenosha, Wisconsin

Specify Macwhyte PREformed Elevator Ropes to your maintenance man

NO. 787-E

MACWHYTE
PREformed ELEVATOR ROPES
The CORRECT Ropes for your Equipment

STOP FISH

BY ELECTRONICS

Available Now on Your Priority

This patented fish control method employs modern electronics in overcoming a serious operating and maintenance problem. Fish of all sizes are kept at a *safe distance* from intake structures, or screens, by the use of an Electronic Control Unit. This equipment, generating special electrical impulses, energizes an electrode system designed and engineered for your particular fish control problem.

The Burkey Electric Fish Screen has been thoroughly proven through years of service in Condensing Water Intakes, Hydroelectric Plants, Water Systems and Industrial Pumping Installations. DOES NOT STUN OR KILL FISH.

Recommended by State Conservation Officials.

Free literature and quotations upon request.

Electric Fish Screen Co.

1130 No. Poinsettia Place
Hollywood 46, California

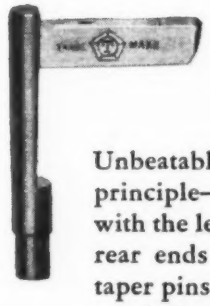
Leadership

DEVELOPS THE TOOLS OF VICTORY

Boeing B-29 Superfortress

When Pacific strategy called for super long-range bombers . . . aircraft engineers solved the problem with the Superfortress! Industry, too, has needed many specialized tools for its part in the war. For pipe threading, highly advanced tools developed by TOLEDO were ready at the earliest call of defense. Through its program of constantly thinking ahead in research, engineering and manufacturing for nearly half a century . . . TOLEDO has pioneered many basic improvements in pipe tools. In the future as in the past, TOLEDO Leadership will continue delivering better Pipe Tools for every job!

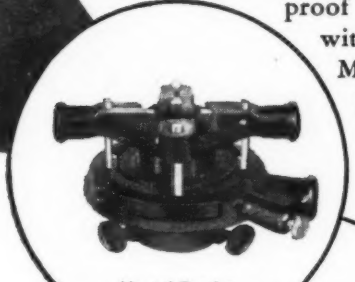
☆ ☆ ☆



TOLEDO *Pioneered* THIS EASY THREADING WAY!

Unbeatable performance results from the TOLEDO receding die principle—which produces the smoothest, most perfect threads with the least effort! The die segments lie loose in their slots, the rear ends resting against the tapering surface of hardened steel taper pins or tapered steps. As the thread is cut the dies recede, producing a smooth, full tapered thread that assures tight, leak-proof joints. Another reason for better performance with Toledo Tools! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector St. Bldg.

"TOLEDO"
TRADE-MARK REGISTERED



No. 1A Ratchet 1" to 2" Threader

TOLEDO

PRECISION PIPE TOOLS

ADAMANT
FIRE BRICK CEMENT

START NOW . . .
to reduce costs of furnace maintenance

Lay-up linings with Adamant . . . its higher bonding strength (see below) protects the structure at the joints where failure usually begins. Result . . . linings last longer . . . production is maintained . . . repair costs and replacement materials saved.

ADAMANT
Stronger by Test

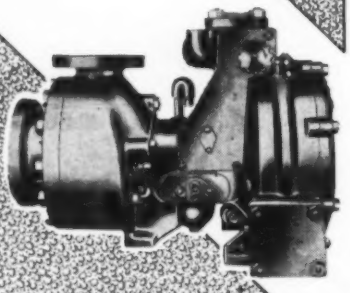
Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature; 1270 lbs. at 2600° F. Adamant has a P.C.E. of 3000° F. plus. For more details, write

BOTFIELD
REFRACTORIES COMPANY

784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

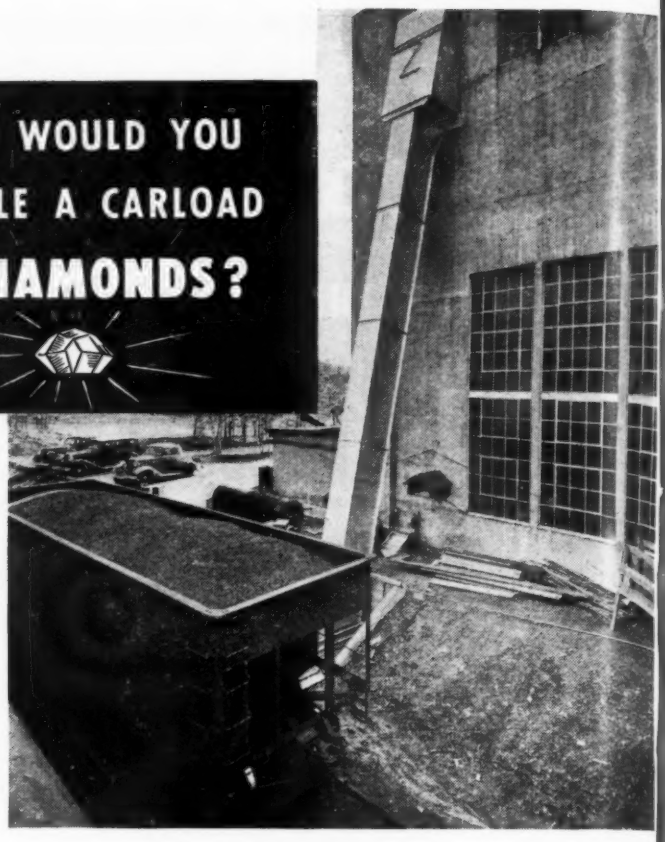
COFFIN TURBO PUMPS

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



THE J. S. COFFIN, JR., CO.
ENGLEWOOD, NEW JERSEY

HOW WOULD YOU HANDLE A CARLOAD of DIAMONDS?



If that carload of "BLACK Diamonds" were WHITE diamonds . . . you naturally would be careful to transfer the entire shipment from your siding into your boiler room "vaults" speedily and without loss. You would give serious consideration to your choice of the conveyor, elevator, hoist, and storage silo that must handle and store this precious commodity.

Well, coal, in the coming months may be almost as valuable as diamonds—and thus deserves most careful conservation of the supply now available.

To help you in your conservation problem, G-W offers the advantages of its 130 years of experience in the design and fabrication of equipment for coal storage and handling—also ash handling.

G-W equipment includes all types of conveyors, elevators, skip hoists and carriers; a full line of bunkers, gates, hoppers, spouts, ash cars—also silo storage plants and industrial rail systems.

G-W engineers are trained to fit the proper equipment to your particular conditions and requirements . . to adapt standard designs to specific applications . . . or to design complete new equipment and systems . . . all to the traditional G-W reputation for efficiency, ruggedness, long service and high quality workmanship.

Send for Catalog P-200. It describes and illustrates many types of boiler-house equipment, coal storage and material handling systems. You'll find in its 125 pages many useful ideas on handling materials—with emphasis on coal—for your post-war production schedules.

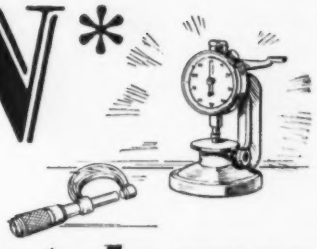
GIFFORD-WOOD CO.
FOUNDED 1814

420 Lexington Ave.
New York 17

HUDSON, N. Y.

565 W. Washington St.
Chicago 6

PRECISION*



....you find it in the highest degree in Marsh Gauges

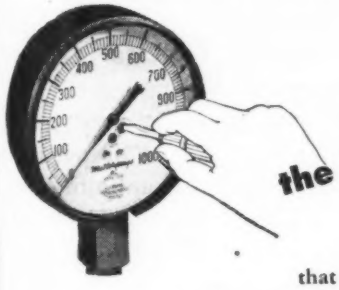
WHEN people want to describe precision in its highest achievement, they speak of "watch-like" precision or "instrument-like" precision. And they are right: No product requires more precise and painstaking craftsmanship than a device like a pressure gauge or dial thermometer.

Long ago that respected craftsman, the "instrument maker" achieved precision with his own skilled hands. Today the problem is to achieve equal—yes, even greater precision—on a production basis. This calls not only for skill, but for specialized machines and methods.

Space permits only a few highlights of the ways in which precision is attained in Marsh Gauges—even the most moderately priced Marsh Gauges. The steps illustrated are typical of many more that we could cite such as the finely cut gears and pinions, the precise fitting of bearings and staffs, the elaborate set-up of jigs, fixtures and production line gauges which hold machining within microscopic limits.

Yes, if you wanted to describe precision in its highest degree you could find no better expression than *"Marsh-*like" precision. Remember this when you need pressure gauges and other instruments of the type we manufacture.

JAS. P. MARSH CORPORATION
2075 SOUTHPORT AVE., CHICAGO 14, ILLINOIS
Export Department: 155 E. 44th St., New York 17 N. Y.



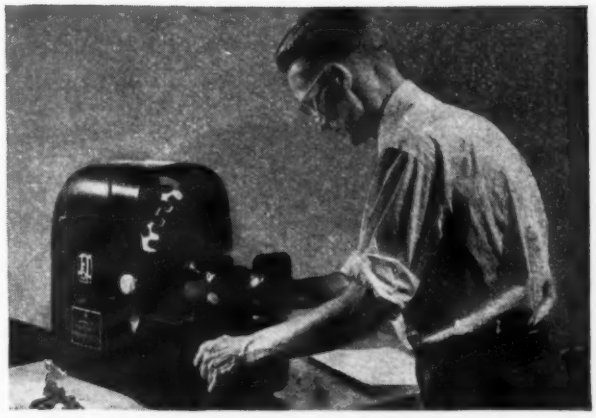
the gauge with the "RECALIBRATOR"

— quickest and best way to correct a pressure gauge that has been knocked out of adjustment—the finishing touch to a better gauge.

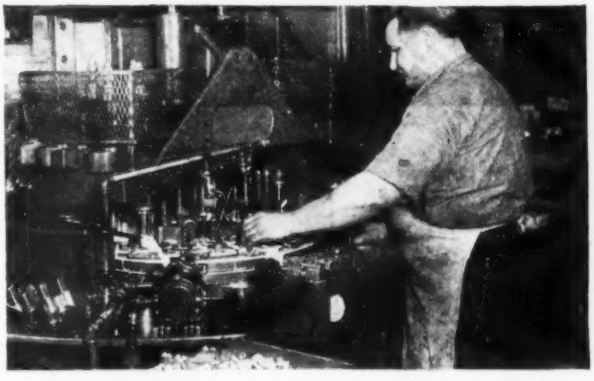
***One of a series of advertisements covering factors that make Marsh Instruments "THE STANDARD OF ACCURACY"**

MARSH GAUGES

DIAL THERMOMETERS
HEATING SPECIALTIES



Modern version of the watch-maker's eye-piece is the "comparitor" which magnifies the meshing of rack and pinion teeth fifty times. Faults are seen—and corrected.



They must be alike. Many operations on the sockets of Marsh Gauges are performed rapidly, simultaneously and with unerring accuracy by this highly developed special machine—one of many special machines that give you more precision at no greater cost in Marsh Gauges.

Skill and method combine here to give bourdon tubes the proper form and resiliency—another tube-forming operation is so exclusive that we perform it behind locked doors.

Hovalco Angle Valves used in combination with (1) Homestead Lever-Seald or (2) Cam-Sealed Quarter-Turn Valves meet the requirements of A.S.M.E. code and all state laws for boiler blow-off service. Made in 1½"—2"—2½" sizes for pressures up to 600 pounds.

HOVALCO BOILER BLOW-OFF VALVES

- *Are built to outlast the boiler*
- *Reduce maintenance costs by 30% to 60%*

Inside every HOVALCO BOILER BLOW-OFF VALVE is an "extra" set of accurately-ground, perfectly-matched *seating surfaces* ready to be put into service quickly and easily, when the need arises. By simply unbolting the lower valve body and turning over the special high-silicon monel seat and disc, you have a good-as-new valve ready to give *another* extra long lifetime of service.

That's why Hovalco Blow-Off Valves give double-service life and often outlast the boiler on which they are installed. Also, certified performance records show that their maintenance costs are 30% to 60% lower than those of other valves.

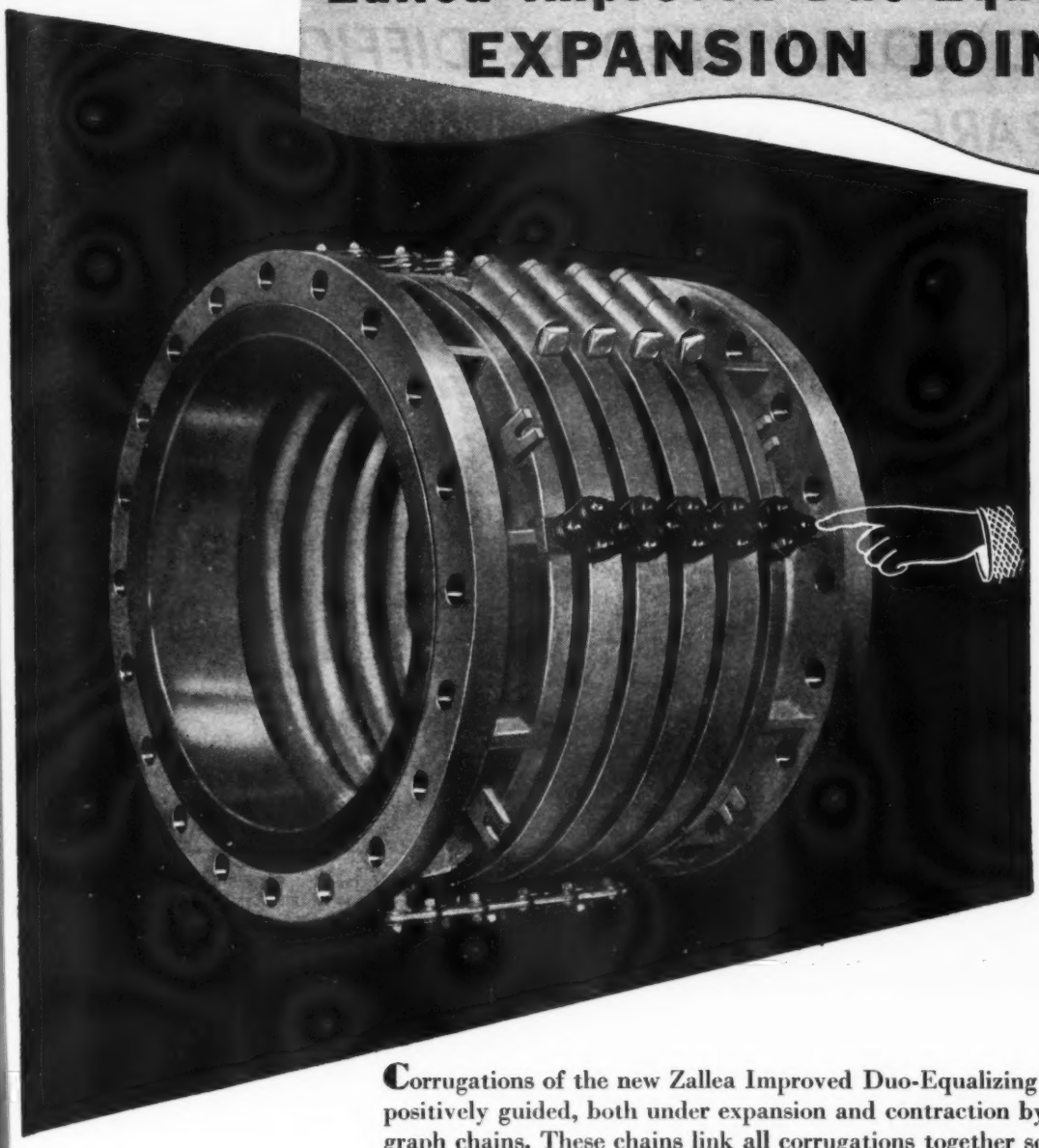
For double service life and lowest cost-per-year maintenance, specify HOVALCOS for your next boiler blow-off job. Choose sizes and types for your condition from Valve Reference Book No. 38. Write today.

"M" Pennant with three additional gold stars—Maritime's highest production award to our men and women making valves for the Victory Fleet.

HOMESTEAD VALVE MFG. CO.

P.O. BOX NO. 210 CORAOPOLIS, PA.

Zallea Improved Duo-Equalizing* EXPANSION JOINT



The Pantograph Chain Does It!

Corrugations of the new Zallea Improved Duo-Equalizing Expansion Joint are positively guided, both under expansion and contraction by two or more pantograph chains. These chains link all corrugations together so that each one must move equally and simultaneously with all others. This new design feature results in an expansion joint which can confidently be relied upon for the maximum possible life for any particular set of operating conditions.

Zallea Improved Duo-Equalizing Expansion Joints can be supplied in sizes from 4″ to 30″ diameter, of copper and many types of stainless steel. For special corrosive applications other metals can be furnished, including Monel, Inconel, nickel and Supernickel. They are built for traverses from a fraction of an inch up to 7½″ in a single unit, for pressures from vacuum to 300 psi, and for temperatures from sub-zero to 1600° F.

Let us quote on your expansion joint requirements. For complete description and specifications of the new Zallea Improved Duo-Equalizing Expansion Joint, write for Bulletin 45.

*U. S. Pat. Pending

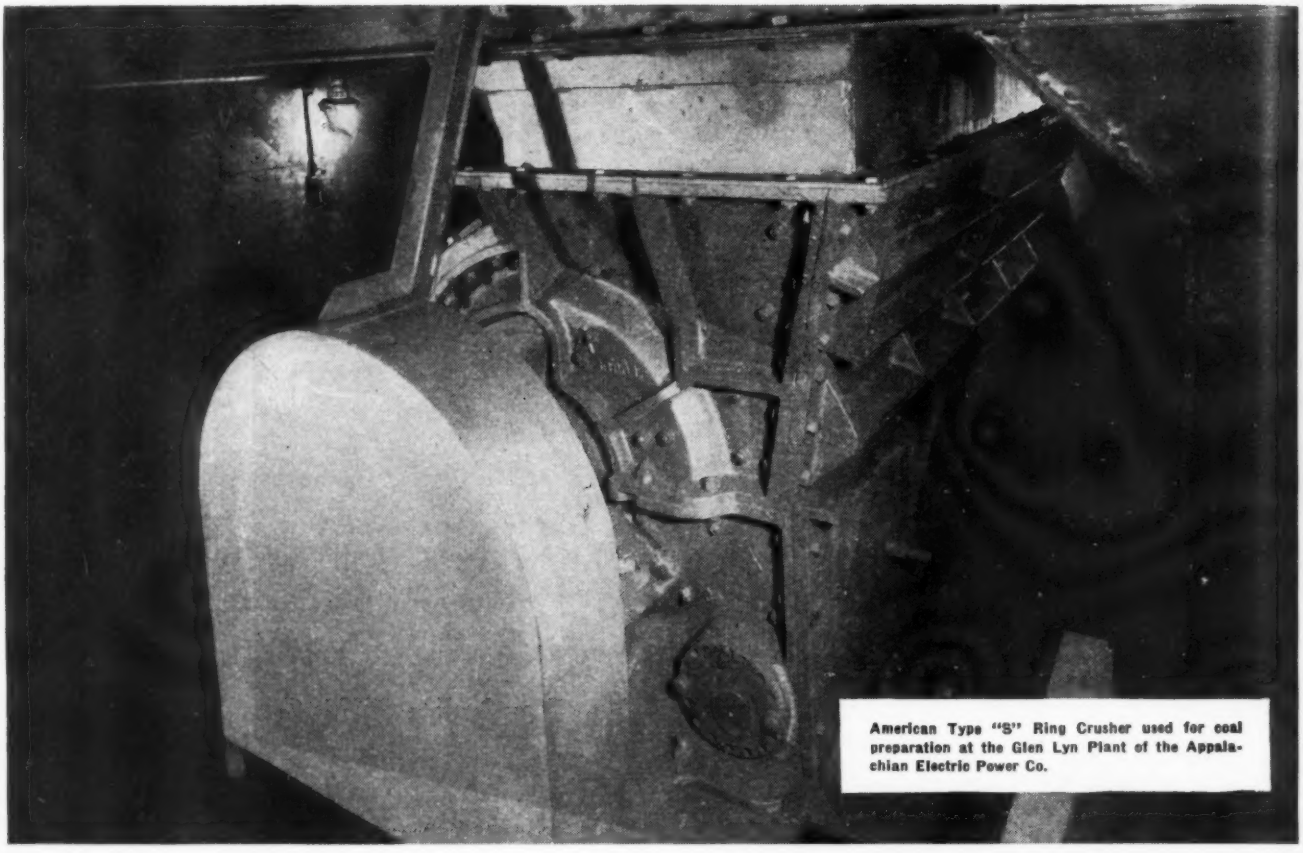
"Code-Craft"...

ZALLEA BROTHERS & JOHNSON

...EQUIPMENT FOR THE PROCESS INDUSTRIES

814 LOCUST ST. • WILMINGTON 99, DEL.

NO COALS NEED BE DIFFICULT . TO PREPARE . . . with AMERICAN RING CRUSHERS



American Type "S" Ring Crusher used for coal preparation at the Glen Lyn Plant of the Appalachian Electric Power Co.

The "AMERICAN WAY" *is the Economical Way*

With the possibility of limited coal selection for many plants, it is important that facilities for coal preparation be adequate and sufficiently versatile to handle any of whatever coals are available.

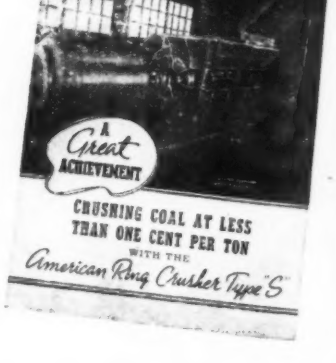
The fact that the American Ring Crusher can be adapted to any kind of coal, and that the size of the finished product can be varied to meet the method of firing makes the "American" the logical one to install in new plants or in the modernization of existing plants.

By delivering coal of uniform size to stoker or pulverizer, the American assures good economy in steam generation. Experience has shown that in moderate size industrial plants, operating efficiencies have been increased from 2½% to 8%. In larger, more modern plants, overall efficiency may be raised at least 3%. In all cases, coal is prepared the "American" way at a total cost of less than 1¢ per ton.

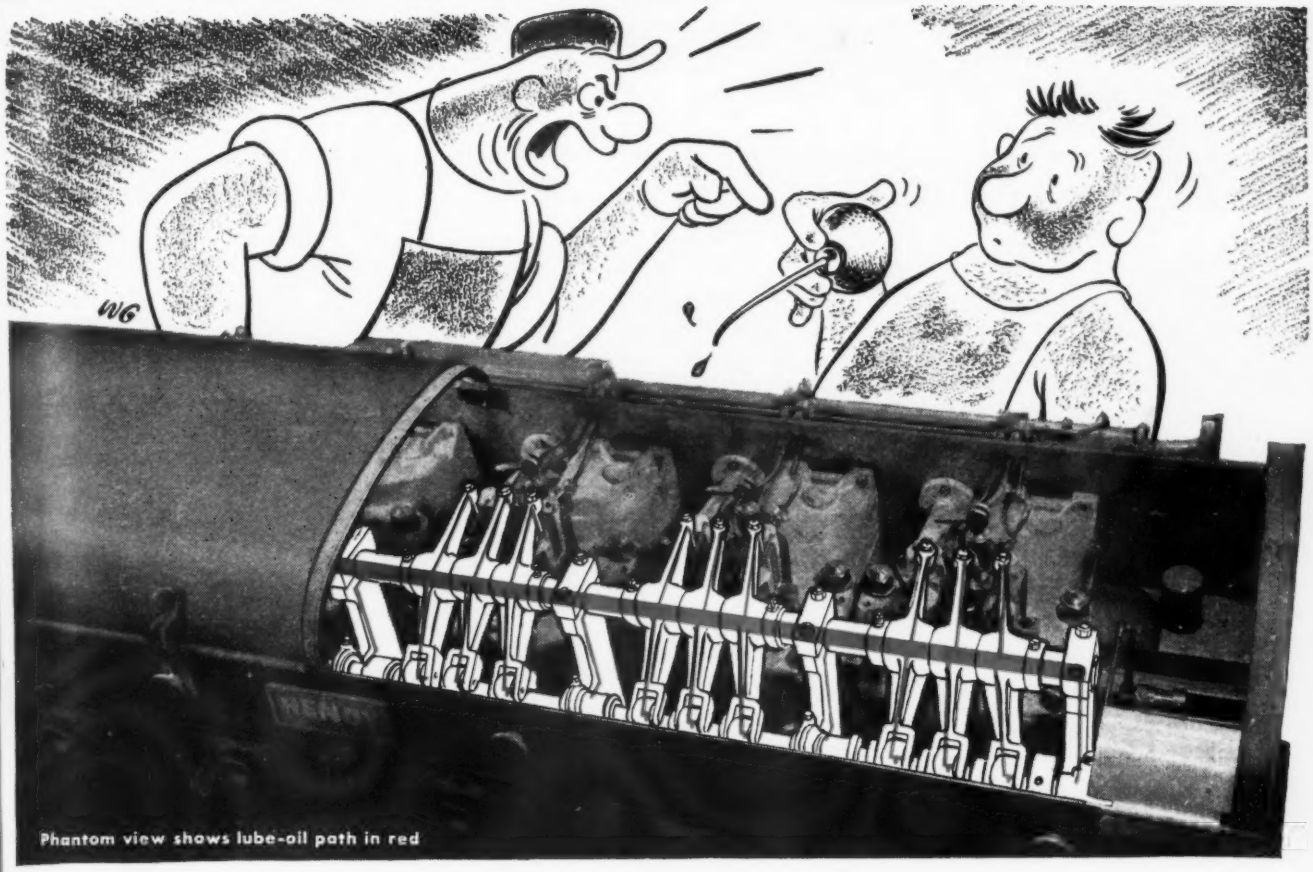
Investigate the tried and proved, versatile, economical "American Way" immediately and be prepared for any eventuality as regards coal availability.

Send for

a copy of Bulletin "Crushing Coal at Less than One Cent a Ton" which shows in detail the features of the "American" which assure economy and efficiency in crushing all grades of coal.



AMERICAN PULVERIZER COMPANY
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1219 Macklind Avenue
St. Louis, 10, Missouri



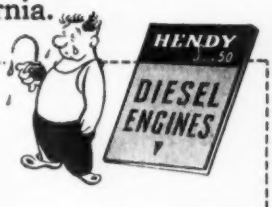
Phantom view shows lube-oil path in red

"Put DOWN that oil can, Lube-oil Reuben!"

No need to hand-oil any part of a Hendy Series 50 Diesel! It's completely enclosed, so *all* parts are oiled from the pressure-lubrication system . . . automatically . . . in correct amounts, neither too much nor too little.

Series 50 Diesels have advantages never before combined in a single design. Besides full pressure lubrication, they have overhead camshafts, unit fuel pumps and injectors, oil-cooled pistons, and many other features.

Now, for the first time, you can have the benefit of *all* these features in *one* tested and reliable Diesel. For complete information, mail the coupon today to Joshua Hendy Iron Works, Sunnyvale, California.



Send for NEW Diesel Booklet
No Obligation

JOSHUA HENDY IRON WORKS
SUNNYVALE, CALIFORNIA

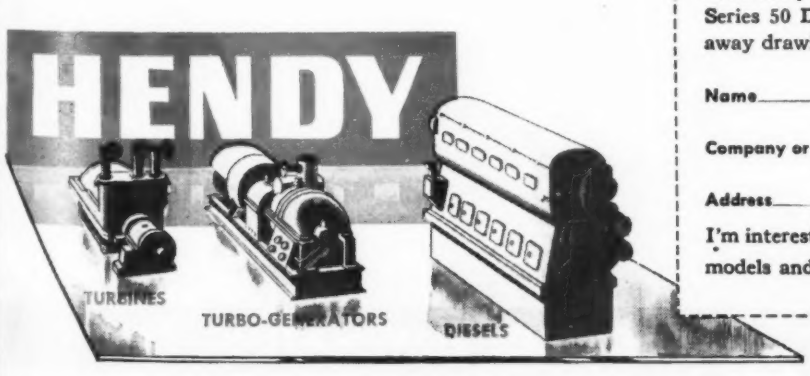
Mail me your new booklet that completely describes the Series 50 Diesel, with photographs and cross-section cutaway drawings showing the design of all major parts.

Name_____ Position_____

Company or business _____

Address_____

I'm interested in Marine ☐ Stationary ☐ Diesel-electric ☐
models and in hp ranges from 190-250 ☐ from 250 up ☐



100-D-17

Production-based on AIR

Outstanding production records have been set by American Industry. In many cases, this high production has been dependent on an uninterrupted supply of POWER—either steam or electric, or both. Since the modern power plant depends entirely on mechanical draft, fans have had an important part in making these production records.

In chemical plants, paper mills, munitions factories, airplane and tank factories, textile mills, rubber factories, food processing plants—in huge central stations, Buffalo Forced and Induced Draft Fans are on three-hundred sixty-five day service. On some of these jobs, where "overload" conditions exist, the draft fans have had service in four years equivalent to many years of peacetime operation.

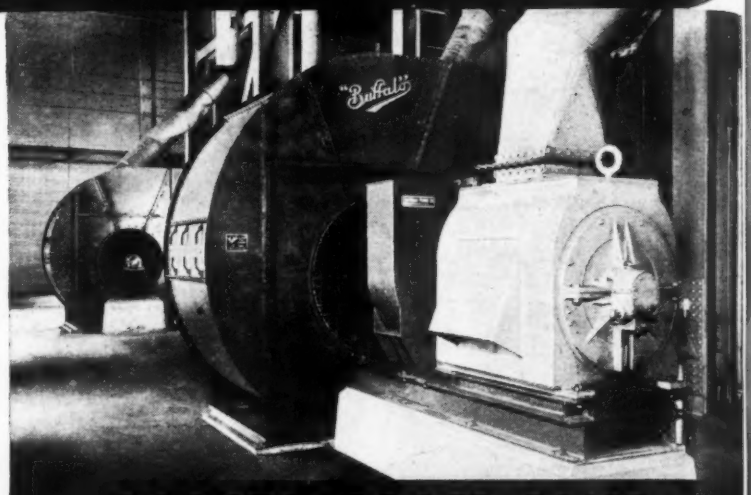
Because of the "over-size" design and the durable, rigid construction of "Buffalo" Fans, they have given excellent service with minimum expense for replacements and repairs.

YOUR power plant deserves good draft fans. Buffalo sales representatives located in all principal cities will be glad to make recommendations.

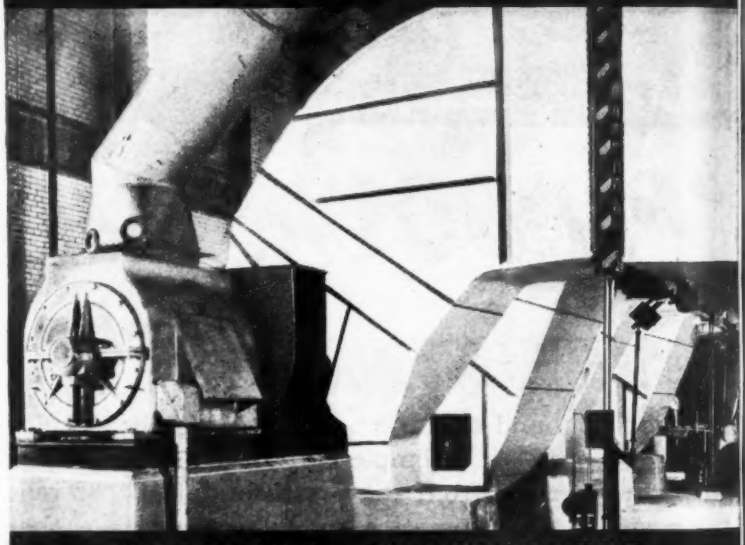
BUFFALO FORGE COMPANY
488 Broadway Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" "First For Fans"

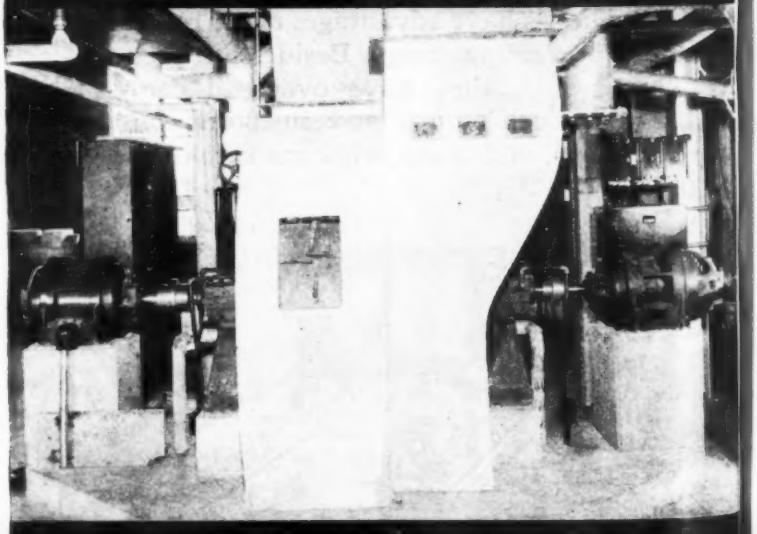
DRAFT FANS



FORCED DRAFT FANS



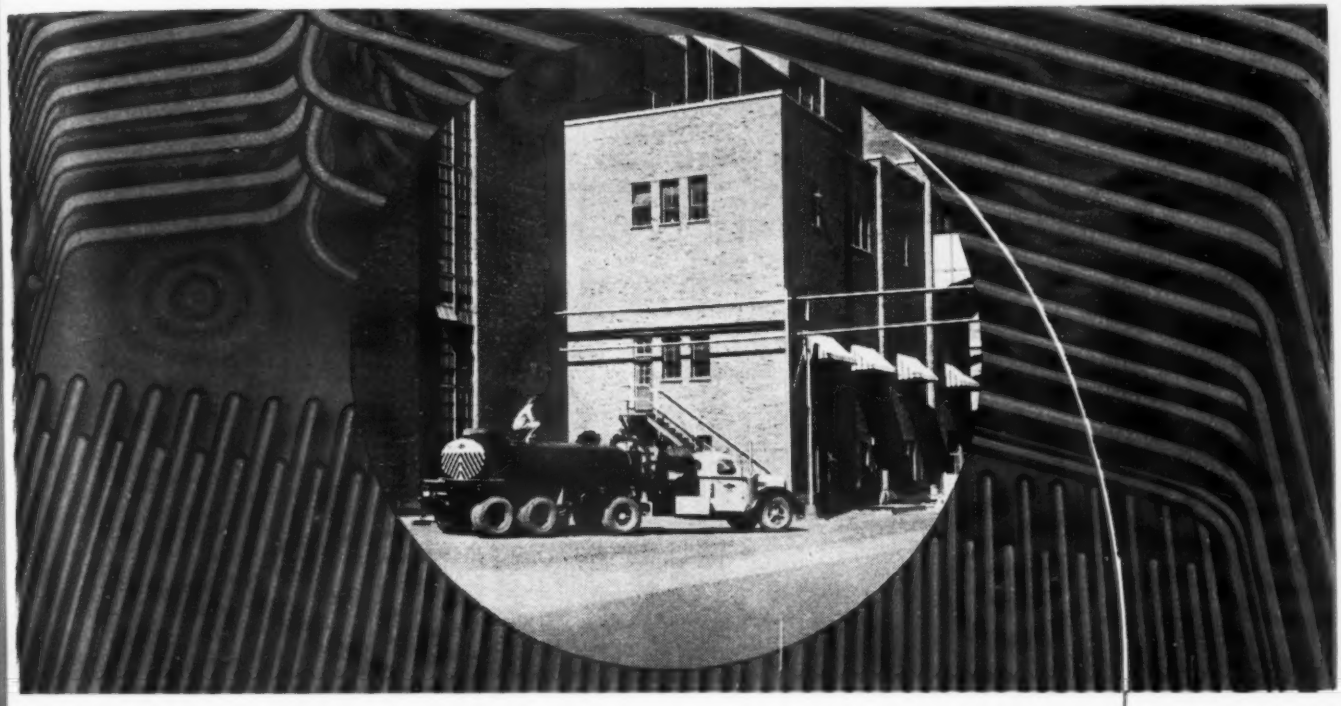
INDUCED DRAFT FANS



CINDER ELIMINATING FAN

DOWELL

CHEMICAL SCALE REMOVAL SERVICE



THOROUGHNESS . . . THE RESULT OF TECHNICAL ANALYSIS AND ENGINEERING

Dowell Chemical Scale Removal Service is used extensively in all kinds of plants in many states for the removal of water- and steam-deposited scales, sludges and oxides. The operators of these plants know from experience the many advantages, the thoroughness, safety and marked economies of the Dowell Methods.

Trained engineers analyze the power-stealing deposits. Types of metal and operating temperatures are determined. In a relatively few hours of down-time, without extensive dismantling of equipment, proper solvents are applied to dissolve, disintegrate and remove the deposits. The result is thorough cleanness and restored operating efficiency.

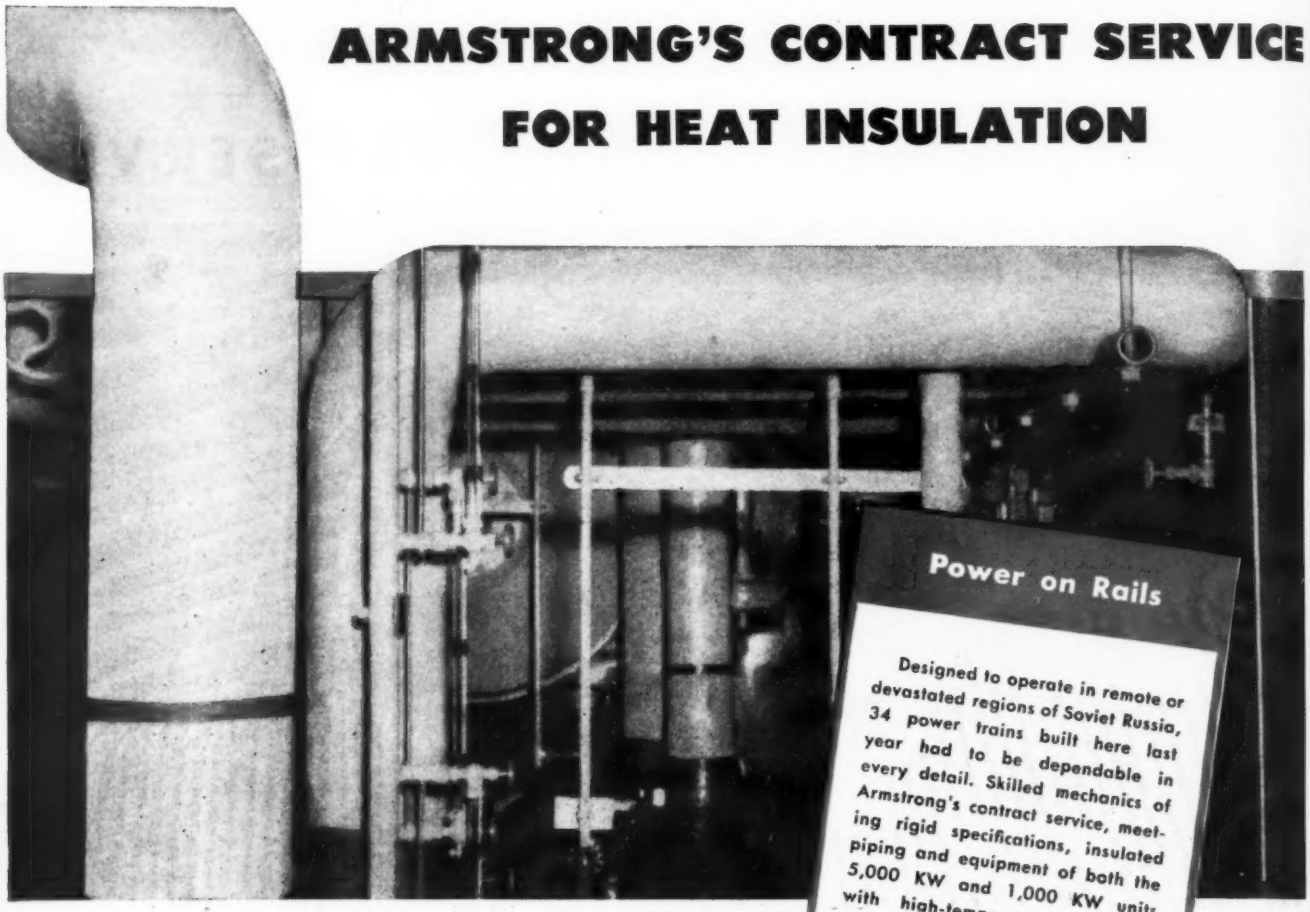
This complete service combines the chemical and engineering techniques of Dowell with the research and technical facilities of its parent organization, The Dow Chemical Company. Obtain further information from the nearest Dowell office.

DOWELL INCORPORATED
Tulsa 3, Oklahoma
Subsidiary of The Dow Chemical Company

New York • Philadelphia • Cleveland • Chicago • St. Louis • Houston
Kansas City • Wichita • Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, California • Casper, Wyoming

Service from Long Beach and Casper provided by a Dowell associated company, International Cementers, Inc.

You can count on a trouble-free job with ARMSTRONG'S CONTRACT SERVICE FOR HEAT INSULATION

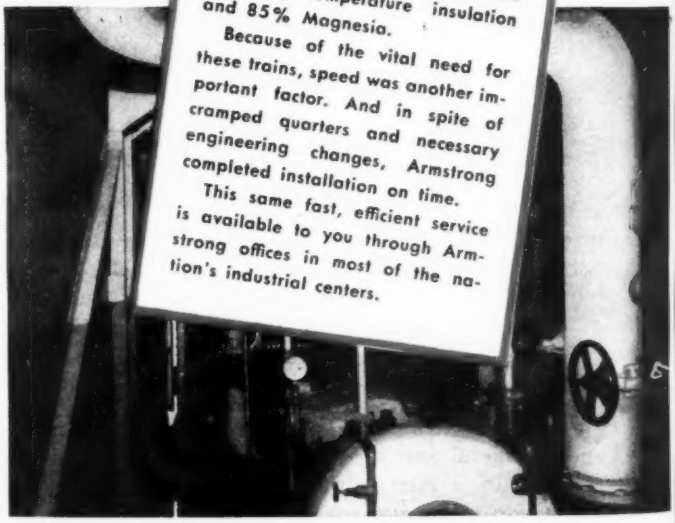


Power on Rails

Designed to operate in remote or devastated regions of Soviet Russia, 34 power trains built here last year had to be dependable in every detail. Skilled mechanics of Armstrong's contract service, meeting rigid specifications, insulated piping and equipment of both the 5,000 KW and 1,000 KW units with high-temperature insulation and 85% Magnesia.

Because of the vital need for these trains, speed was another important factor. And in spite of cramped quarters and necessary engineering changes, Armstrong completed installation on time.

This same fast, efficient service is available to you through Armstrong offices in most of the nation's industrial centers.



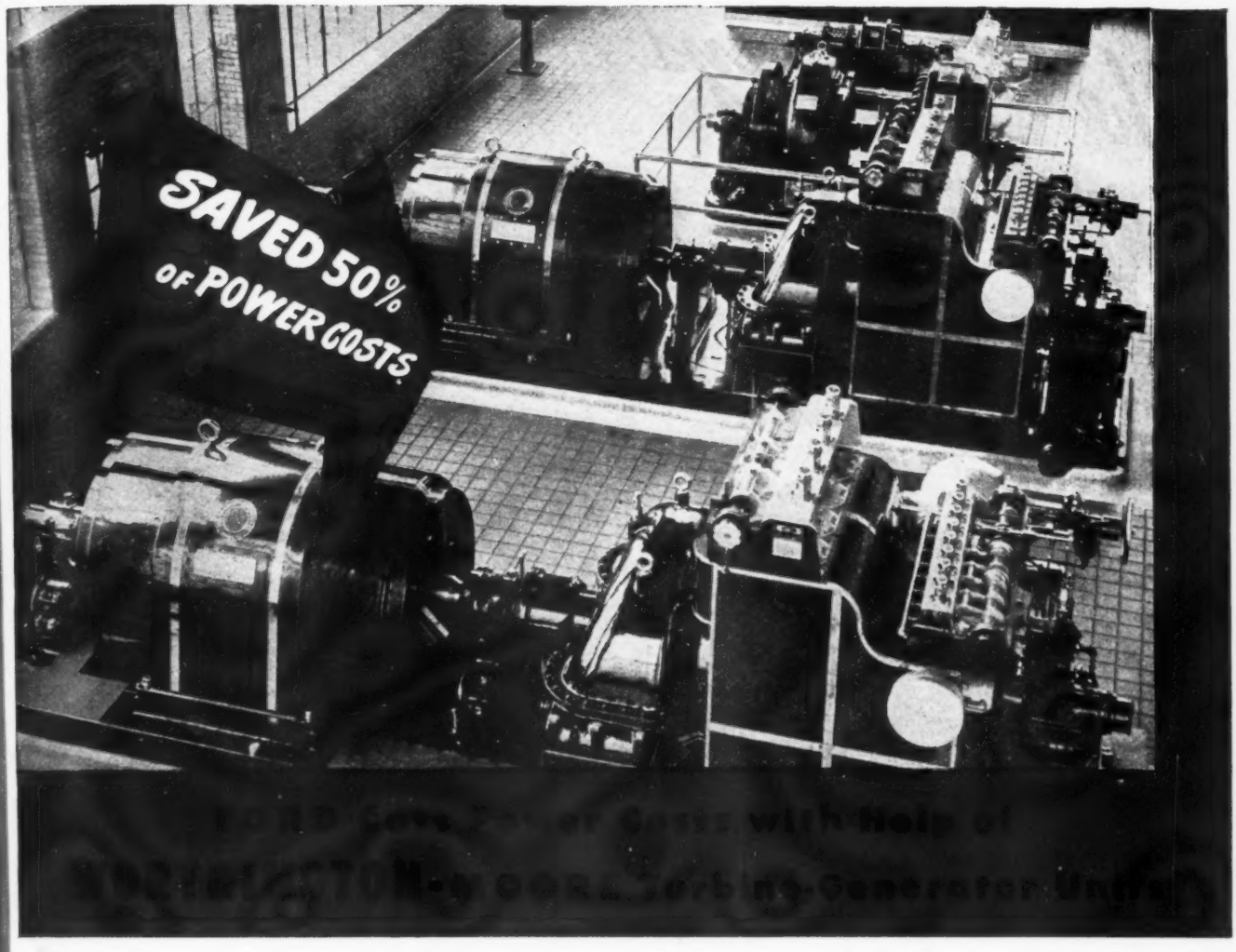
FOR COMPLETE DEPENDABILITY, you can confidently turn your heat insulation job over to Armstrong's contract service. This big, experienced organization takes full responsibility for every phase of planning, supervision, materials, and installation. In addition, you enjoy the advantage of Armstrong's wide engineering background, its materials of tested and proved efficiency, and the skillful workmanship of its mechanics. For complete details, write today to Armstrong Cork Company, Building Materials Division, 7005 Concord Street, Lancaster, Pa.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2600° Fahrenheit



Power costs have gone down 50% in the Ford Motor Company's Chicago power plant near the Calumet River. This is another example of how *modern* automatic extraction type turbines can cut power costs, far below costs of older methods of power generation. Superintendent reports "excellent service record during the period since installation with no interruption."

Engineered to Fit the Job

Taking 225 lb. 525° steam at the throttle, the Worthington-Moore turbines exhaust to the condensers, and automatically extract steam at 5 lbs. pressure to satisfy variable process and heating steam requirements.

Investigate WORTHINGTON-Moore Teamwork

In many other turbine-generator installations, firms like yours have profited from Worthington's broad experience with steam power plant equipment, plus Moore's years of turbine engineering and manufacture. Write us, or call our nearest district office. *Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, N.Y.*

WORTH BEHIND THE NAME
WORTHINGTON

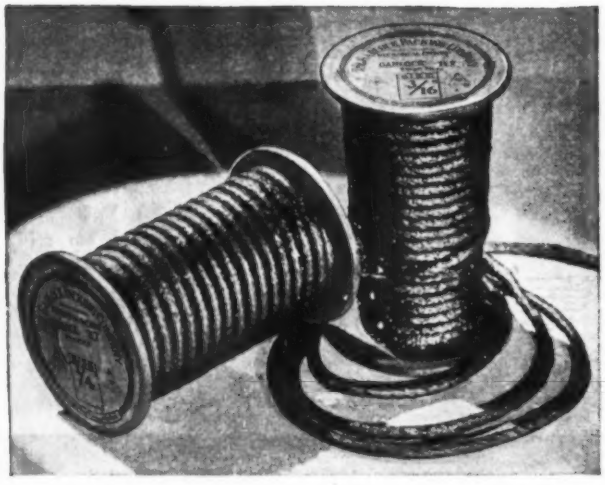
MR 4-8

A GREAT TEAM IN STEAM

The Boss Says

"NOW I CAN RELAX"

With GARLOCK Packings, Gaskets and KLOZURE Oil Seals installed throughout the plant, the boss can relax. Frequent shut-downs for repacking, etc., are avoided . . . production zooms along without interruption . . . orders are filled . . . and everybody's happy. Standardize on GARLOCK for dependability and long service.

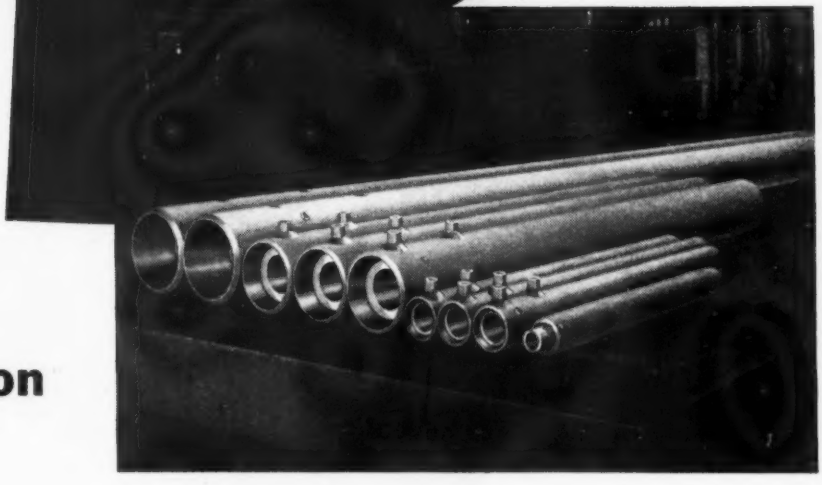


GARLOCK 117 globe and angle valve stem packing is equally effective against high pressure steam, hot or cold water, or oil. Furnished either braided or twisted in all sizes from $\frac{1}{16}$" to $\frac{3}{4}$".

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Garlock

Shop Fabrication

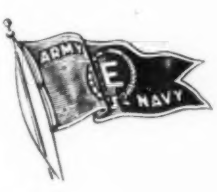


a *Must* in Precision Pipe Prefabrication

THE illustrations above depict the installation of Flow Nozzles in pipes of various sizes. This is another phase of shop fabrication involving operations which cannot be satisfactorily performed in the field. Pipe ends must be accurately bored, flow nozzles and holding rings properly located, centered, pinned, and welded. Instrument taps must also be carefully welded into exact position. Such precision fabrication is necessary to definitely assure accurate registering of instruments when the assembly is installed in a functioning system to measure the flow of steam, water, or other fluids.

The prefabrication of safe, accurate, and economical piping involves not only the services of qualified experts in all fabricating operations from engineering to final test, but requires adequate shop facilities and modern equipment as well.

On your next piping job, whether it involves a single unit or a complete system, let our engineers work with you. There is no obligation. Contact our nearest representative or write us direct.



DO MORE THAN BEFORE—BUY EXTRA WAR BONDS

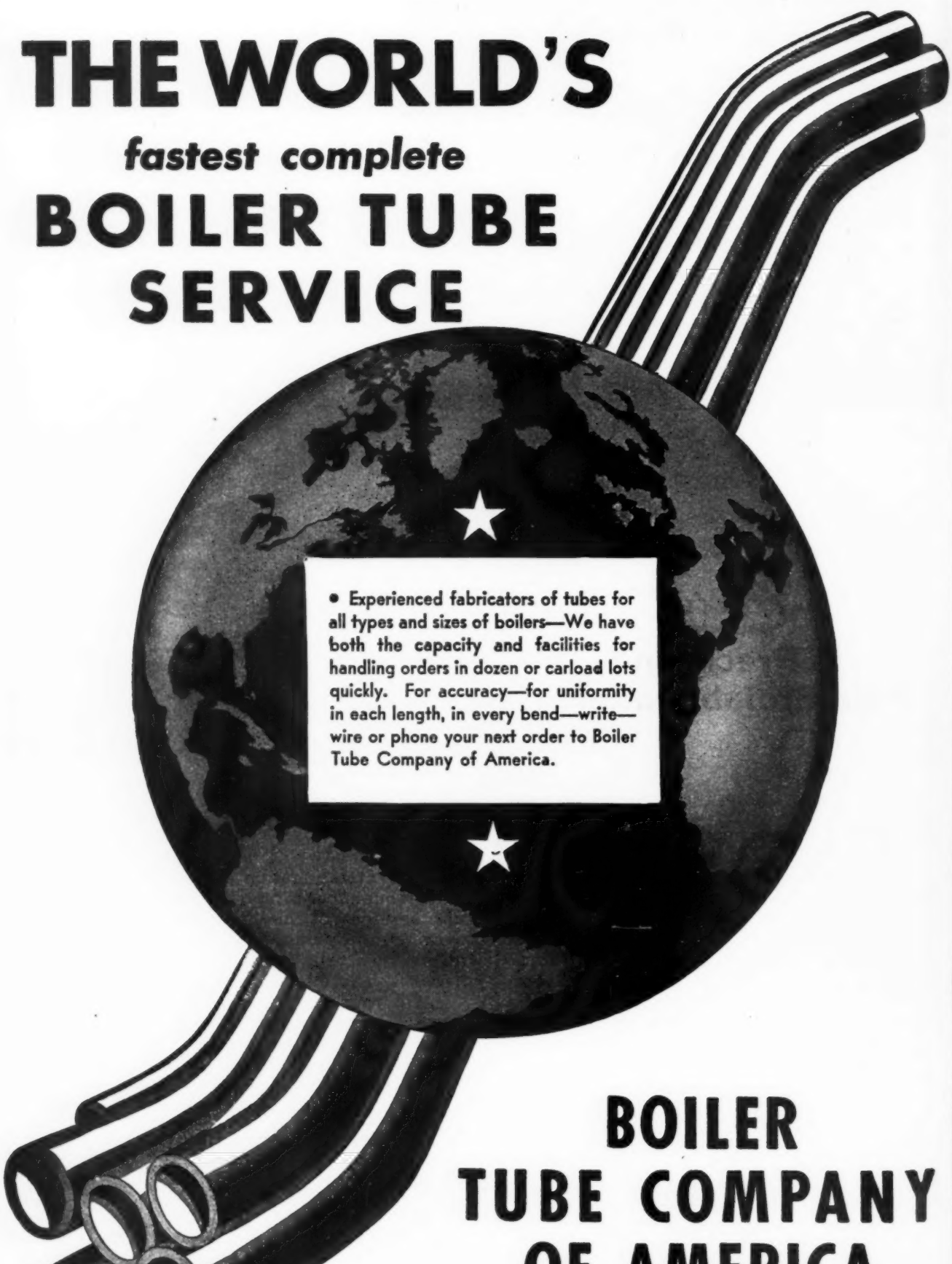
Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Occidental Building, Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston
434 S. Grameercy Place, Los Angeles

THE WORLD'S

fastest complete

BOILER TUBE SERVICE

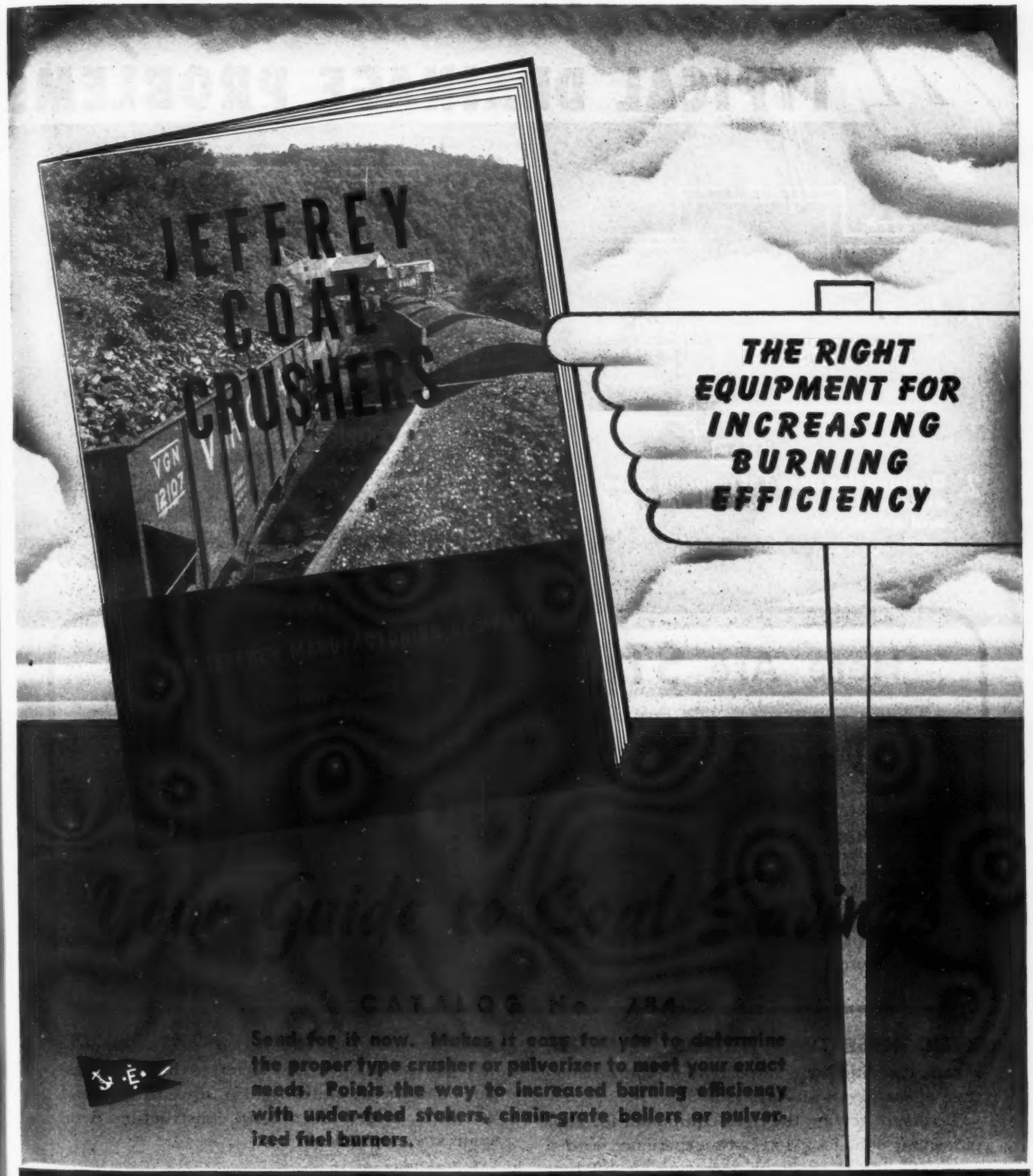


• Experienced fabricators of tubes for all types and sizes of boilers—We have both the capacity and facilities for handling orders in dozen or carload lots quickly. For accuracy—for uniformity in each length, in every bend—write—wire or phone your next order to Boiler Tube Company of America.

BOILER TUBE COMPANY OF AMERICA

3126 PREBLE AVENUE
PITTSBURGH, PA.

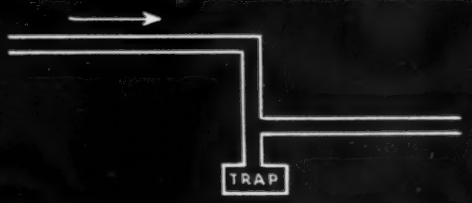
PITTSBURGH • NEW YORK • PHILADELPHIA • CHICAGO


JEFFREY
COAL
CRUSHERS
THE RIGHT
EQUIPMENT FOR
INCREASING
BURNING
EFFICIENCY
CATALOG No. 284
Send for it now. Makes it easy for you to determine the proper type crusher or pulverizer to meet your exact needs. Points the way to increased burning efficiency with under-feed stokers, chain-grate boilers or pulverized fuel burners.
JEFFREY
ESTABLISHED 1877

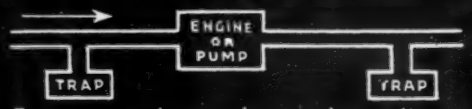
4 Keep Your Steam Dry! TYPICAL DRAINAGE PROBLEMS

1. Piping shows natural drainage point. CONDITION: Line sometimes shut off, requires air elimination and self priming.

2. Draining line ahead of reducing valve or similar equipment. CONDITION: Off and on service.



3. Trap at natural drainage point. CONDITION: Slugs of water and wide pressure fluctuation.



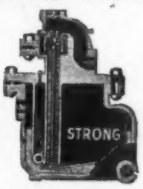
4. Traps on main supply or exhaust lines of separators of engines and pumps. CONDITION: Pulsating steam pressure.

Here Are STRONG'S Suggestions:

1 and 2

Strong inverted bucket traps will handle large quantities of air, and when properly sized, have ample capacity to handle peak condensate loads during the warm-up period.

3 and 4



Strong open bucket traps operate only when bucket is full of condensate. Ideal for lines subject to pulsation. Also recommended in many cases where pressure varies widely.

Sizing: Peak condensate load during warm-up governs trap capacity needed on steam main service. In off-and-on service, peak load occurs when steam flow begins. *Recommendation:* Provide trap capacity 3 times condensate load of radiation, if pipe were bare, using full steam pressure without consideration of superheat.

KEEP THESE TWO THINGS IN MIND!

Steam specialties are important in the satisfactory operation of any system.

To insure getting the right equipment for your particular job, look for both experience *and* a complete line of products operating on different principles.

Recommendations of Strong engineers are based both on long experience—and a complete line including open and inverted bucket traps, float-and-thermostatic (blast), etc., in cast and semisteel, forged and welded construction. Send your steam problems to:

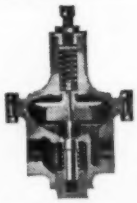
STRONG, CARLISLE & HAMMOND CO.
CLEVELAND 13, OHIO

REG TRADE MARK

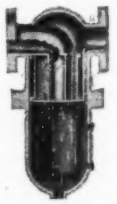
OTHER **STRONG** STEAM SPECIALTIES

ANUM-METL Reg Trade Mark

Strainer

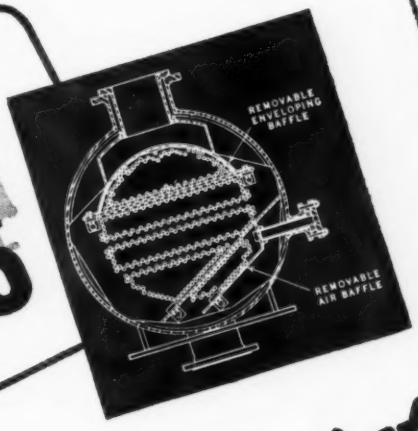


Reducing Valve



Separator

BAFFLES



. . . an important element of efficient STAGE HEATER design

ONE OF A SERIES OF ADVERTISEMENTS DESCRIBING THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

Look to the baffles if you want to make sure you will get most complete and efficient transfer of heat from steam to water as well as prevention of wear of tubes in the stage heaters you buy.

The baffle design and arrangement of G-R Stage Heaters are based on more than seventy-five years of experience in building closed water heaters. For example, the patented G-R enveloping steam baffle provides cross-over temperatures with superheated steam. This exclusive design not only permits heating the boiler feed water several degrees above the dry and saturated temperature of the extraction steam, but also is the only type of baffle that prevents the superheated steam from coming in contact with the heater shell, so as to prevent excessive expansion strains and possible warping.

The steam impact baffles, drain inlet baffles and air baffles, too, all have distinctive advantageous features in G-R Stage Heater designs. To learn about these exclusive benefits, write for our Bulletin 277 which describes in detail the various G-R designs for all pressures, temperatures, and plant requirements.

G-R BUILDS ALL THESE UNITS FOR HEAT TRANSFER SERVICE . . .

Evaporators
Stage Heaters
Gas Coolers
Drain Coolers
Aftercoolers
Air Preheaters
Fuel Oil Heaters
Jacket Water Coolers
Process Heat Exchangers
Transformer Oil Coolers
Generator Air Coolers
Lubricating Oil Coolers
Storage Tank Oil Heaters

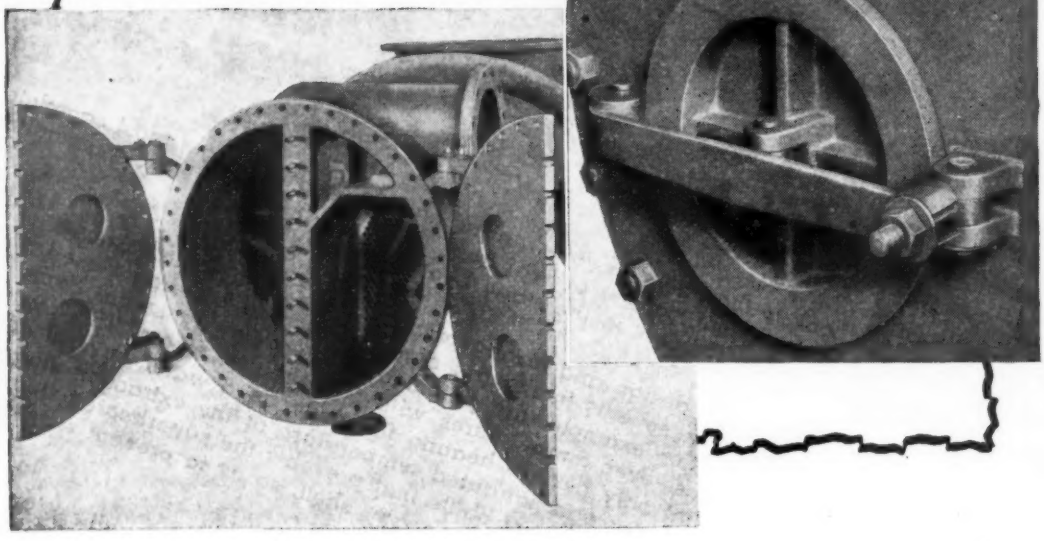
THE GRISCOM RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

condenser tubes fouling from bad circulating water conditions?

ROSS

SPECIAL FEATURES HELP YOU CUT TIME AND PERFORMANCE LOSSES



If you are forced to circulate brackish water containing industrial waste, you're going to be confronted with tube clogging and corrosion.

Losses in vacuum can be as much as 2 inches within a week.

Given no alternative to this bad water supply, there is no preventative for the fouling, *but there are ways to partially correct the serious losses in performance and manpower.*

Special features for easy maintenance make Ross Surface Condensers exceptionally well suited to these difficult conditions.

For instance, quick-opening inspection ports permit fast and frequent examination of tube sheets and tube ends (without need of opening entire cover). Fouling can, therefore, be detected before it has advanced too far. Then, when tube cleaning becomes necessary, the simplicity and ease of opening the water box covers materially reduce the service time. (Doors are self-aligning and mounted on hinges equipped with roller bearings. No special tools are needed to open or close—only a wrench.)

Full particulars in Ross Surface Condenser Manual No. 4017. Request only on your Company letterhead.

ROSS HEATER & MFG. CO., Inc.

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

1415 WEST AVENUE BUFFALO 13, N. Y.

As every power man who has ever experienced one will testify . . . transformer fires are plenty tough, and plenty costly if they're not licked quick! And, like other types of electrical equipment, a transformer can be seriously damaged by the wrong fire extinguishing medium.

There's one quick, safe way to lick transformer fires. That's with a mass discharge of non-damaging, non-contaminating carbon dioxide . . . as controlled and applied by a Cardox Fire Extinguishing System . . . engineered for the specific hazard it covers.

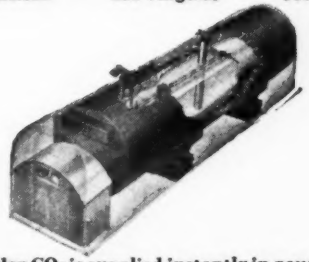
How Cardox Systems quickly tame large or small transformer fires, and why those who have seen the phenomenal performance of Cardox Systems against raging transformer fires say the Cardox conception of extinguishment is a significant contribution to practical protection of this vital and costly equipment, is explained fully in the new Cardox Bulletin illustrated above.

Send for this Bulletin today. Read the reprint of File S-63 from the Cardox Case Book. It describes a recent transformer fire detected and extinguished by a Cardox System before nearby personnel were aware the equipment was in danger. Management estimates damage of at least $150,000 would have been unavoidable but for the prompt, non-damaging extinguishment by Cardox.

Bulletin also shows actual step-by-step extinguishment of test transformer fire and reprints description and charts covering other tests made for an electric utility company on simulated substation fire involving 3000 gal. of transil oil . . . and extinguished in one minute.

Write for new Bulletin 955 now. No expense or obligation.

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS
New York • Washington • Detroit
Cleveland • Atlanta • Pittsburgh
San Francisco • Los Angeles • Seattle



Cardox CO_2 is supplied instantly in pounds or tons from a single Storage Unit containing 500 pounds to 125 tons at controlled low temperature of 0°F and 300 p.s.i.

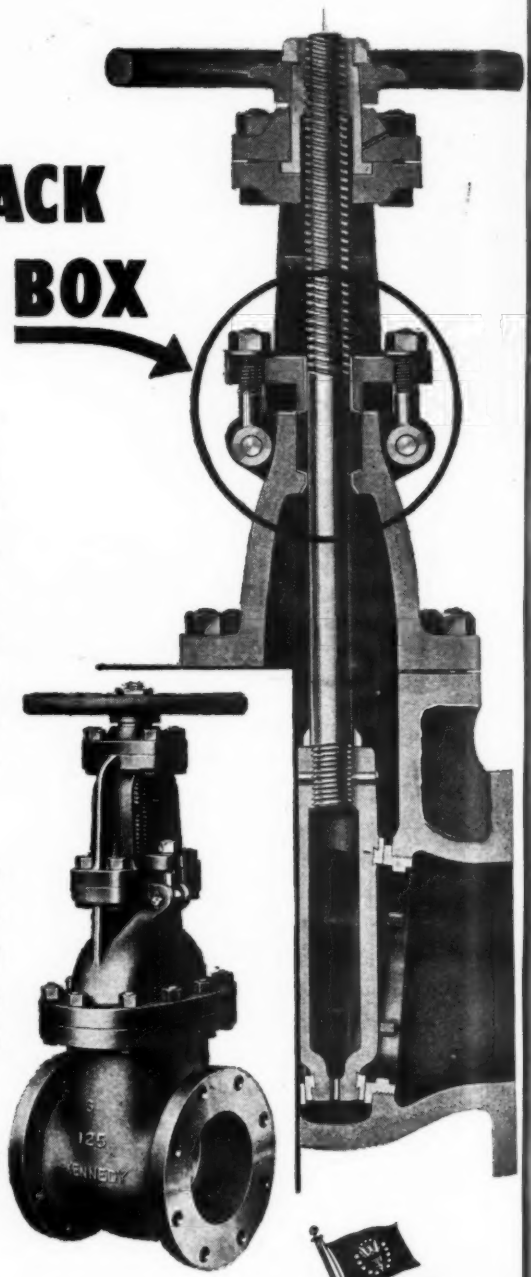
CARDOX
CO_2 FIRE EXTINGUISHING SYSTEMS

"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

"You pack up your troubles"

WHEN YOU PACK THIS STUFFING BOX

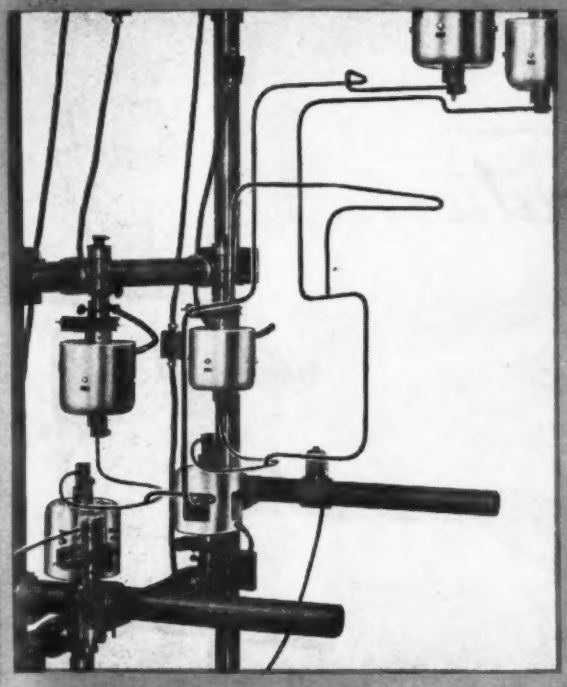


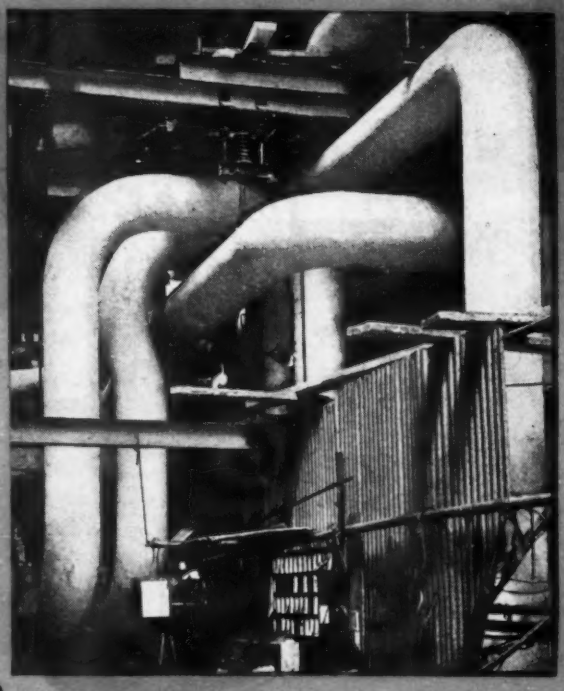
Just check all the conveniences at the stuffing box of this Kennedy Standard O.S. & Y. Iron Body Wedge Gate Valve. Notice the swing bolts that drop out of the way for repacking, the slotted gland that frees the bolts after the nuts have been loosened, the washer type nuts that eliminate loss of washers, the shelves on the yoke to hold the gland out of the way, the bronze bushings at gland and bonnet where the stem passes through, and the generous depth of the stuffing box. The bolts and nuts are rust-proofed, too, so they will not corrode.

No wonder you can pack up and forget all your previous repacking annoyances and troubles when you install these valves. These many conveniences are typical of the careful attention to detail which you will find in all Kennedy valves and which makes it well worth while standardizing on them for your bronze and iron body valve requirements.

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK

KENNEDY
Extra Value in VALVES





KELLOGG

PIPING PROBLEMS
are Solved in Advance in the
KELLOGG LABORATORIES

Extremely accurate stress analysis of scale models, using electrical strain gauges, measuring load deflections to one millionth of an inch, enables Kellogg to furnish piping systems with complete assurance that they will perform as required when the plant is put in operation.

The "bugs" are thus found and eliminated even before the final drawings are allowed to go to the shop. This *design research* explains the acknowledged superiority of KELLOGG pipe installations. This is an exclusive Kellogg service available to consulting, power, process and marine engineers.

KELLOGG

"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.

REPRESENTATIVES

LOS ANGELES 609 SOUTH GRAND · HOUSTON 2, TEXAS 402 ESPERSON BLDG · TULSA PHILTOWER BLDG.

Its greatest critics...

..ARE THE MEN WHO MADE IT!

• From its very beginning, the molding . . . the metal . . . its pouring and finishing—men long experienced in all phases of foundry work carefully nurse, guard and watch over every Sivyer casting.

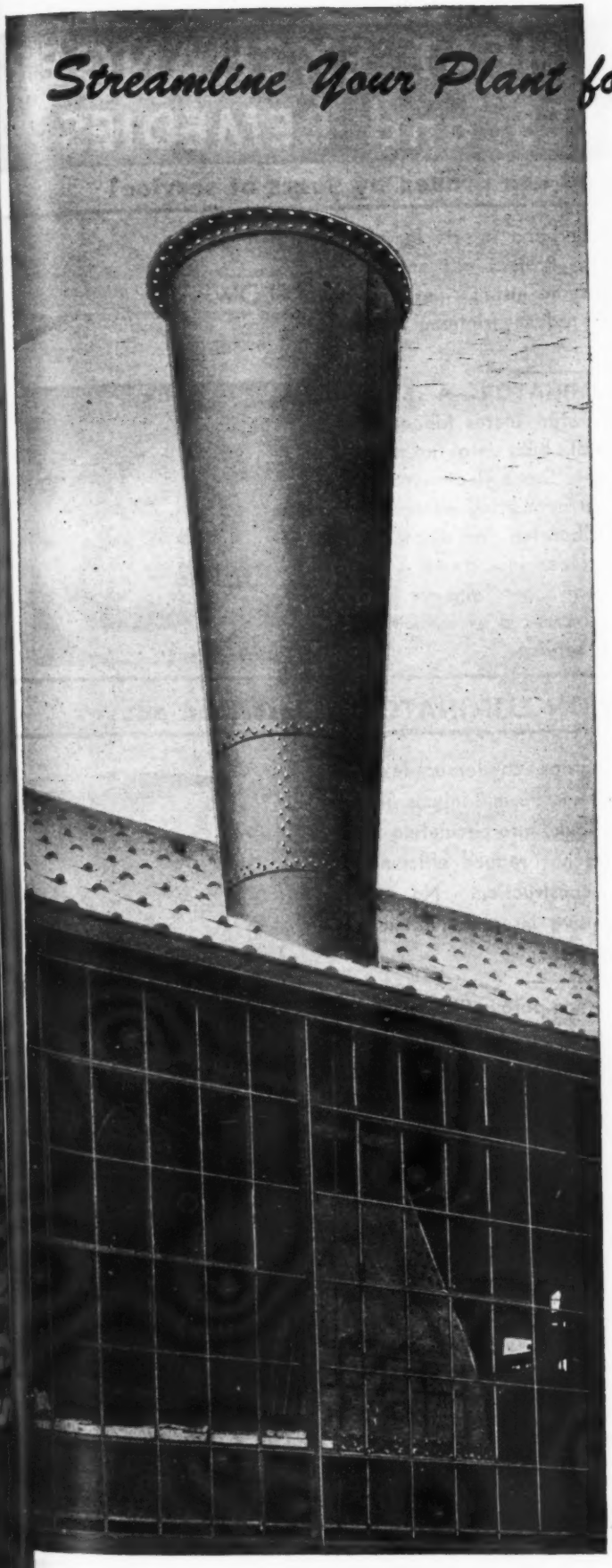
These men insist upon castings as perfect as it is possible to make them. For only by having them this way will they uphold the high standards of Sivyer steel castings . . . entitle them to carry the Sivyer diamond ◈ —the mark worth looking for.

The next time you order steel castings, try Sivyer.

ARMY E NAVY

SIVYER STEEL CASTING COMPANY

MILWAUKEE S CHICAGO S



Streamline Your Plant for Competitive Production

LOWER YOUR PRODUCTION COSTS

with a Thermix INTEGRAL Fan Stack

Do you face the problem of a highly competitive, post-war market? Will you be looking for ways and means to cut costs? Of course! and that's where a Thermix Integral Fan Stack will pay big dividends as it is engineered from start to finish for money-saving efficiency.

The Thermix Stack is far more efficient than conventional cylindrical stacks and induced draft fans because of its divergent design which converts velocity pressure into static pressure. Because of its size, you save initial cost, building cost and operation . . . yet a complete induced draft unit is obtained. Yes, the Thermix Fan Stack is an induced draft fan, breeching and stack, all in one integral unit. It is designed for highest draft efficiency and puts new life throughout your entire power plant.

Write for Bulletin No. 110 today.

•

THERMIX ENGINEERING COMPANY

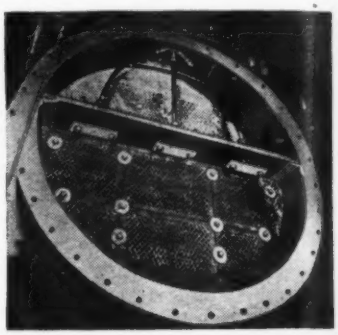
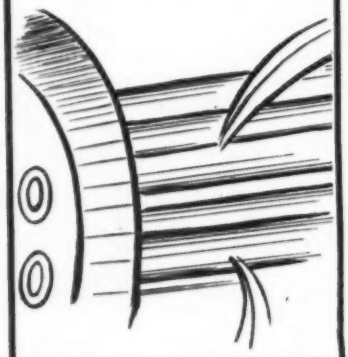
Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

CONDENSER and HEAT EXCHANGER SERVICE TROUBLES and REMEDIES

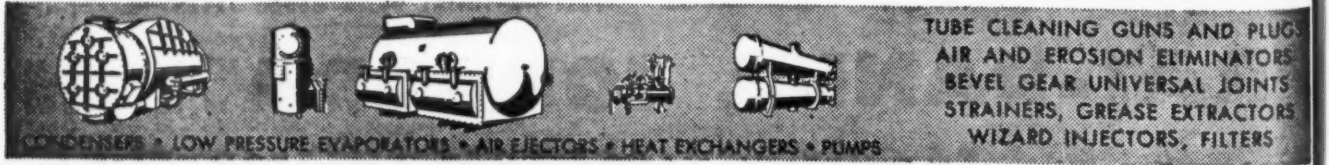
TROUBLE	REMEDY (Tried and proven by years of service)
ERODED TUBE ENDS	**FLOWRITES**—Short, belled-end inserts for condenser tube inlet ends. Protect old and new tubes from erosion. Easy to install. Inexpensive to renew. Venturi effect reduces friction. Proven successful over 20 years. **AIR and EROSION ELIMINATOR**—A special frame containing perforated plates (deaeration screens) of special metal, built into the water box facing the tube sheet. Stops electrolysis and dezincification. Gases in circulating water passing through plates are liberated and discharged through a manifold. Liberated gases attack plates instead of tubes and sheets, and are easily replaceable. Tube life increased at least three times normal. Proven in service. 
DEZINCIFICATION	**AIR and EROSION ELIMINATOR—(Described above)**
LEAKING TUBES 	**WIZARD INJECTOR**—Stops condenser leaks almost instantly, without a shutdown. Injects an inexpensive dry sealing compound into circulating water. Entirely harmless. Does not reduce efficiency of unit. Simple, durable construction. No moving parts. Provides inexpensive insurance against untimely condenser shutdown. **FIBRE PLUGS**—Conseco non-porous fibre plugs will not damage tube sheet. Secured with a light tap. Swell when in contact with water. Easily removed. Inexpensive.
RECURRING TUBE FAILURE	**HYDRO-DYNAMIC SHOCK TESTING,** a patented Conseco feature, offers a positive, accurate method of weeding out poor tubes, with or without dismantling of unit. Eliminates unnecessary retubing of entire unit, and assures against frequent shutdowns. Shock-tested condensers operate for years without further tube failure. Write for facts and figures.

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

SERVICE

CONDENSER SERVICE & ENGINEERING CO., INC.

81 RIVER ST., HOBOKEN, N. J. Phone—HOboken 3-4425 After 6 P.M. or Sundays—HOboken 3-4428


CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS
TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

Steel takes the Backache out of Monday

THIS is Monday in Europe. Even after the war, this age-old routine, familiar to every Continental village, must continue. Steel is too scarce and too expensive over there for most people to enjoy the household facilities that we take so much for granted.

Plentiful, low-cost steel relieves American women of drudgery--makes available to the masses the "luxuries" of running water, automatic laundry equipment, refrigerators, ranges. There is no other metal sufficiently abundant or suitable to take over this job.

For 42 years, Youngstown has helped to convert America into a nation of running water--supplying millions of miles of durable, low-cost steel pipe, fabricated by constantly improved, more efficient methods. Youngstown has also supplied steel sheets for millions of washers and tubs, ranges, refrigerators and other home equipment.

Now, war's demands for steel are being satisfied. But soon we shall resume the unfinished job of **supplying** you, our customers old and new, with dependable, economical pipe and sheets to further eliminate drudgery and advance the American standard of living.

QUALITY — TRADE MARK — YOUNGSTOWN — SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

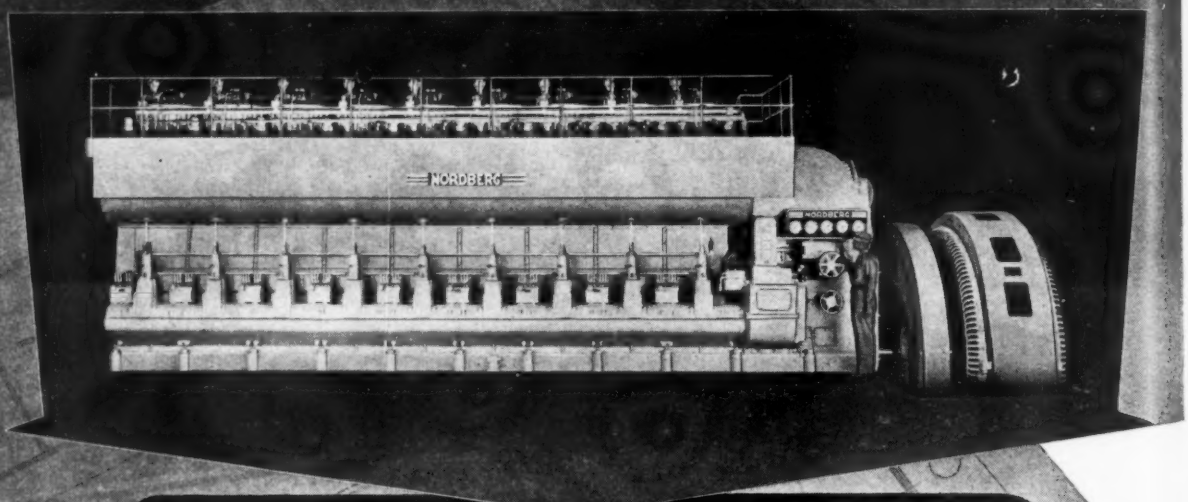
YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate
Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels

Power That Future Plant WITH NORDBERG DIESELS



DEPENDABLE — *proved by many years of service*

ECONOMICAL — *burns heavy low grade fuels*

SIMPLE — *preferred by the operating staff*

ACCESSIBLE — *all parts easily maintained*

RUGGED — *built for long and hard usage*

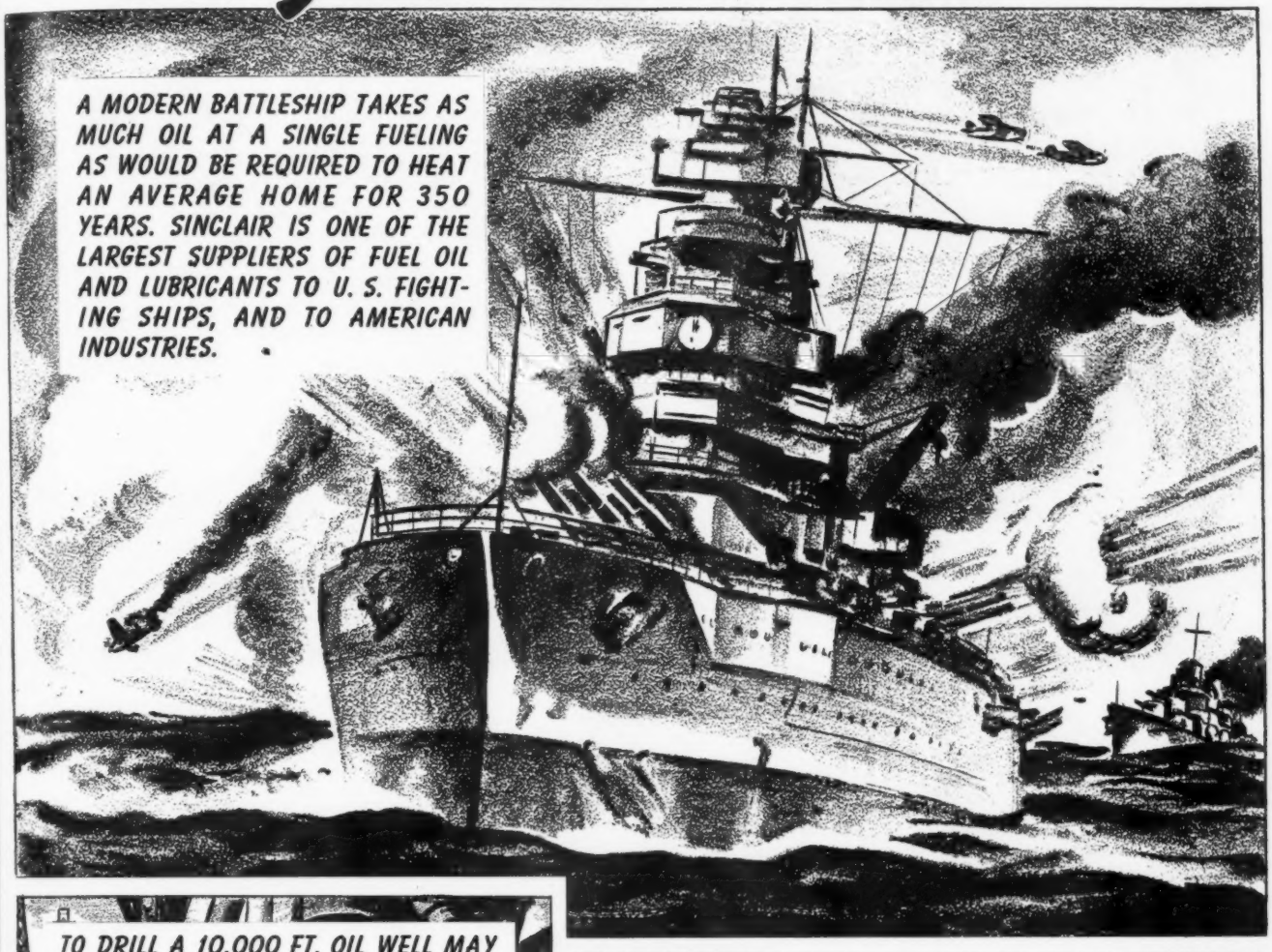
Don't say DIESEL— say NORDBERG

For more than thirty years Nordberg as a leader has contributed greatly to the advancement and development of Diesel engines in America. These years of experience assure to users of Nordberg engines the dependable, economical service that will be required of tomorrow's power plants.

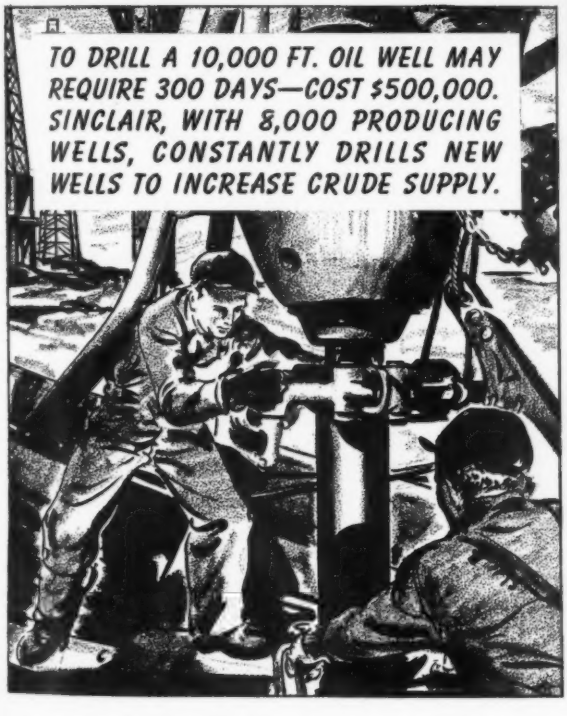
NORDBERG MFG. CO., MILWAUKEE 7, WIS.

NORDBERG DIESEL ENGINES

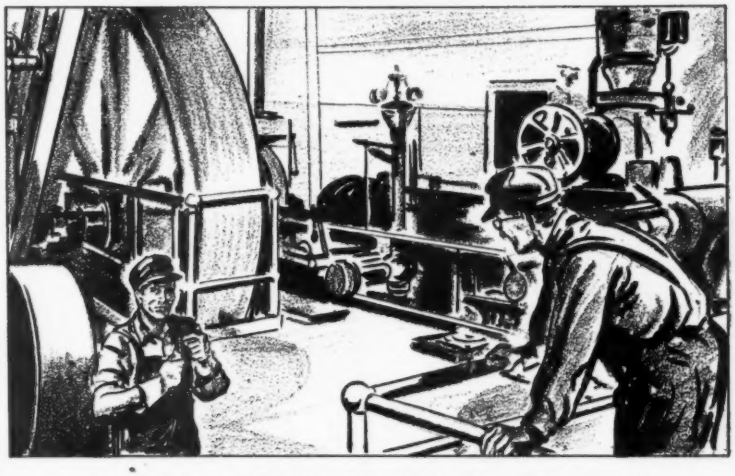
Do you know that . . .



A MODERN BATTLESHIP TAKES AS MUCH OIL AT A SINGLE FUELING AS WOULD BE REQUIRED TO HEAT AN AVERAGE HOME FOR 350 YEARS. SINCLAIR IS ONE OF THE LARGEST SUPPLIERS OF FUEL OIL AND LUBRICANTS TO U. S. FIGHTING SHIPS, AND TO AMERICAN INDUSTRIES.



TO DRILL A 10,000 FT. OIL WELL MAY REQUIRE 300 DAYS—COST $500,000. SINCLAIR, WITH 8,000 PRODUCING WELLS, CONSTANTLY DRILLS NEW WELLS TO INCREASE CRUDE SUPPLY.

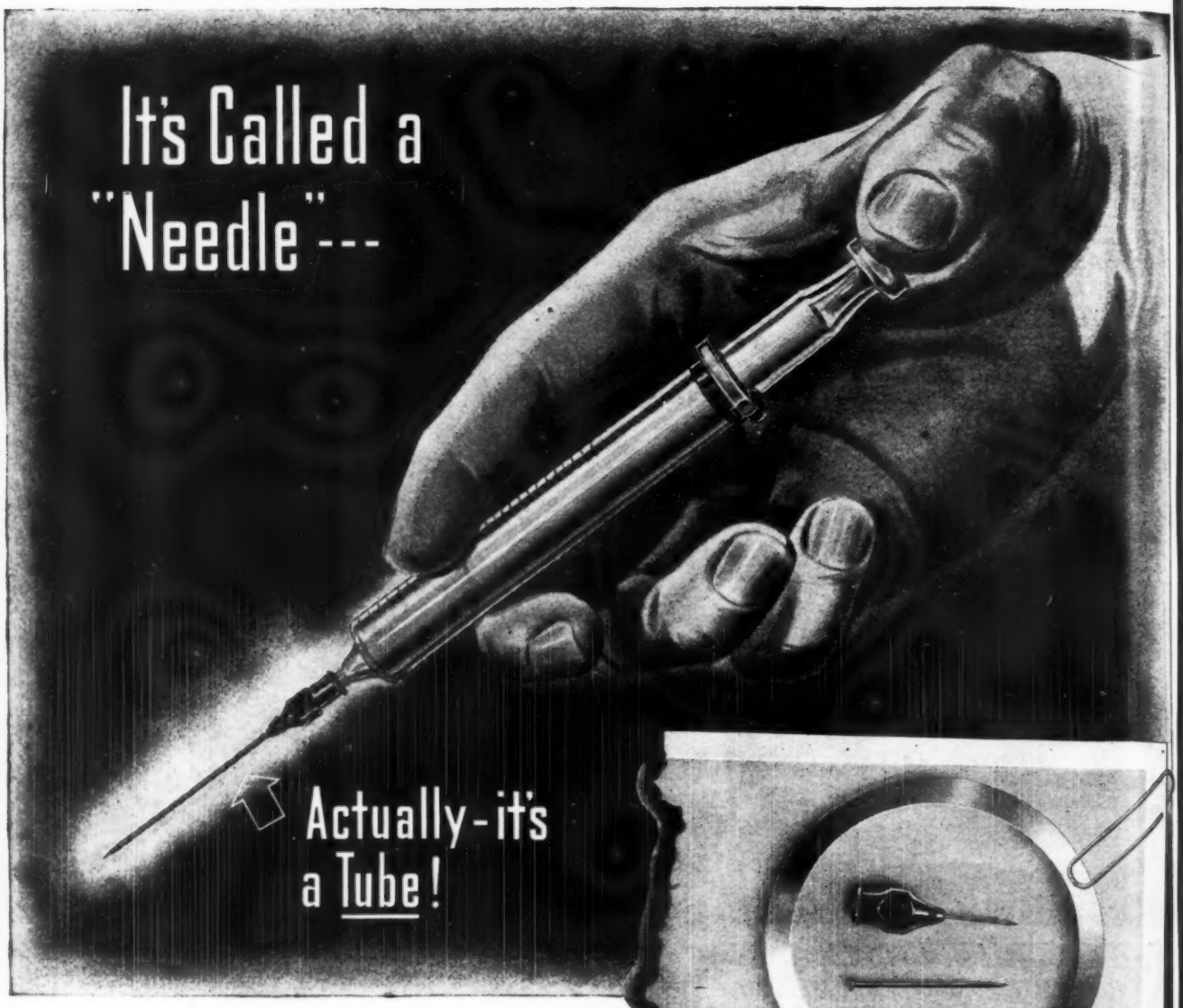


ECONOMIC LUBRICATION UNDER DIFFICULT STEAM PLANT CONDITIONS IS PROMOTED BY SINCLAIR STEAM CYLINDER AND VALVE OILS. THEY ADHERE TO MOVING PARTS, EMULSIFY IMMEDIATELY AND SEPARATE EASILY FOR STEAM RECOVERY.

SINCLAIR *IS EQUIPPED TO SERVE YOU BETTER!*

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

It's Called a "Needle"---



Outside ring is cross-section of hot finished Globe tube which is finally drawn to the hypodermic needle shown in center compared with a common pin.

GLOBE
STEEL TUBES

YES — the hypodermic "needle" is actually a sharpened tube. Its tiny inside channel provides for the air-free flow of serums, antitoxins and other medication into human tissue.

Globe Steel Tubes Co. does not manufacture hypodermic needles but does supply the stainless steel tubing stock from which the needle is drawn to its slender inside and outside diameters.

Because it is highly corrosion resistant, physically and chemically inert to most substances, readily sterilized for complete protection against contamination, stainless steel tubing is used in the manufacture of these needles. Stainless steel supplants much of the platinum formerly used in hypodermic needles.

This is a dramatic example of Globe Steel Tubes Co.'s ability to supply tubing of special characteristics or for unusual applications.

Whatever your requirements in tubes, Globe is equipped by experience and facilities to supply your needs.

GLOBE STEEL TUBES CO., Milwaukee 4, Wis., U. S. A.

GLOBE TUBES

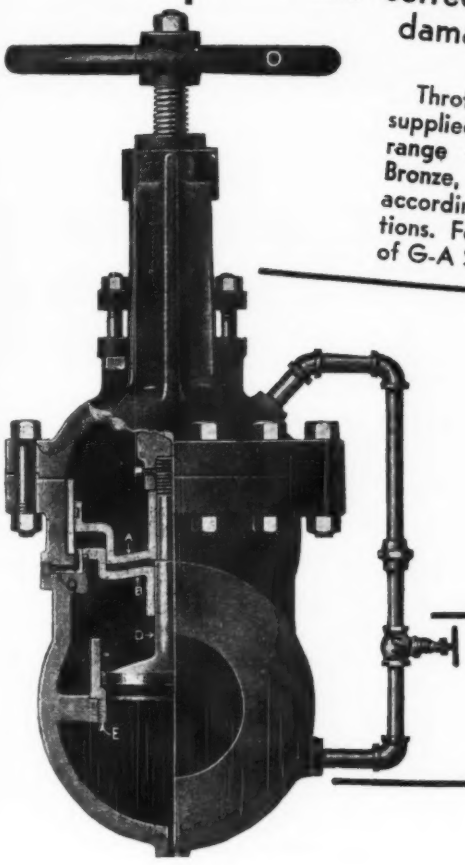
- ★ Pressure Tubes
- ★ Condenser & Heat Exchanger Tubes
- ★ Seamless Stainless Steel Tubes
- ★ Mechanical Tubing
- ★ Gloweld Welded Stainless Steel Tubes
- ★ Globeiron High Purity Iron Seamless Tubes

5020

GET THIS AUTOMATIC PROTECTION AGAINST RUNAWAY TURBINES!

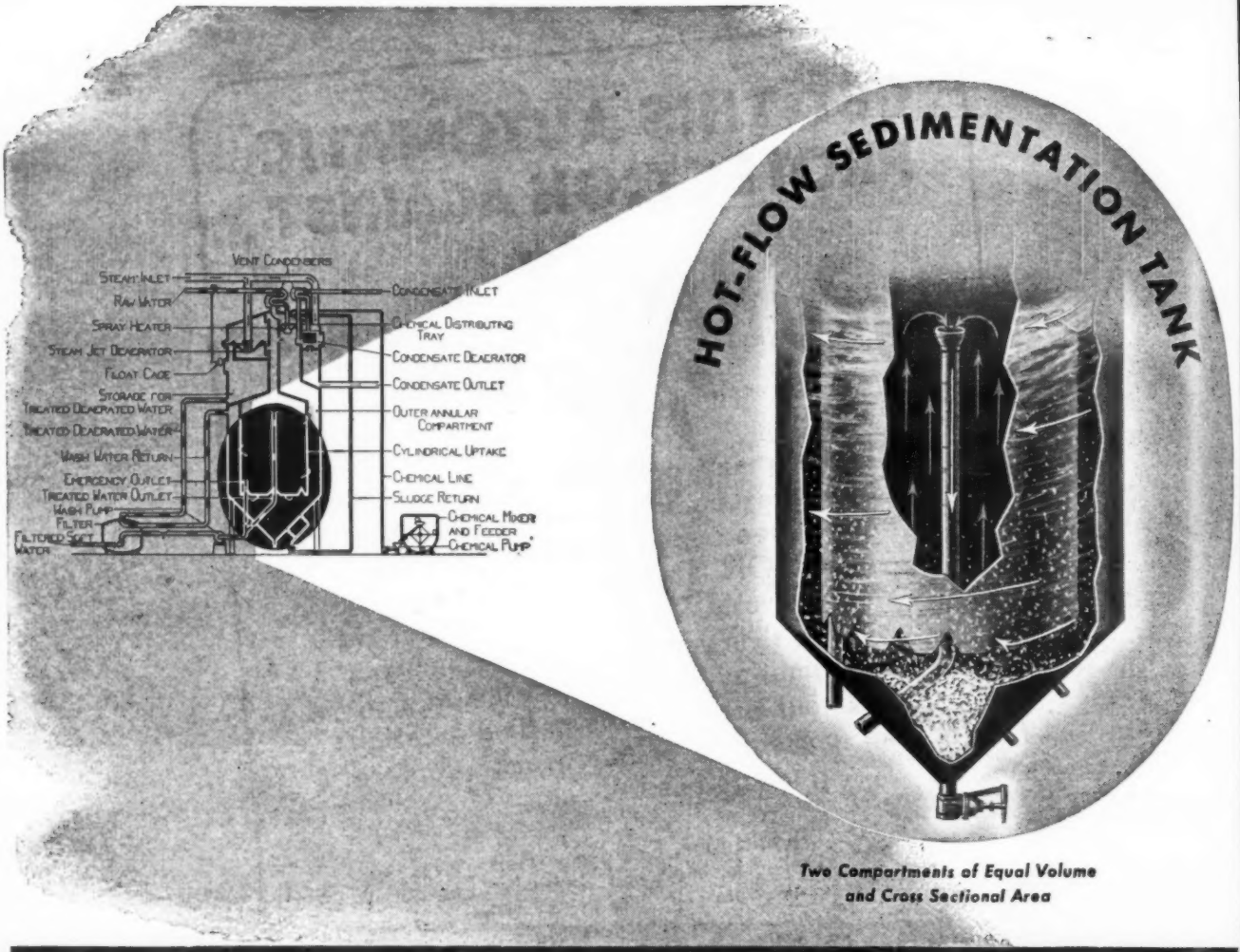
Eliminate any possibility of engines or turbines exceeding maximum safe operating speed by installing GOLDEN-ANDERSON Throttle and Emergency Stop Valves. These valves will act as "sentinels" in your plant and in the event of a runaway turbine, they'll automatically shut off—thus permitting location and correction of the trouble before damage occurs.

Throttle and Emergency Stop Valves are supplied in Angle and Globe Patterns. Sizes range from 2½" to 16". Trim may be Bronze, Monel, Stainless Steel or Gallavoy, according to pressure and temperature conditions. For detailed information on the full line of G-A Specialty Valves write for our catalog.



GOLDEN-ANDERSON
Valve Specialty Company
PITTSBURGH PENN.

Manufacturers of Special Valves for Special Requirements



Two Compartments of Equal Volume and Cross Sectional Area

HOT-FLOW SOFTENERS FOR BOILER FEED-WATER TREATMENT . . . .

PLUS VALUE No. 1 SEDIMENTATION TANK DESIGN

EQUAL VOLUMES: The water must spend half its retention time traveling down the outer compartment—so chemical reactions are completed and solids precipitated long before the water turns upward into the inner compartment.

EQUAL CROSS SECTIONS: There is no variation in velocity of forward travel from inlet to outlet—not even at the point of change in direction of flow.

Thus, this design feature establishes an operating condition conducive to maximum solids separation and sedimentation. The result is an ample volume of properly settled, relatively clear water always ahead of the filters, and this

- **permits 350% overload when backwashing**
- **permits full recovery of wash water**
- **increases the length of filter runs**
- **increases the life of filtering media**
- **reduces operating attention required**
- **eliminates the need for any coagulant**
- **assures high clarity of filter effluent**

INFILCO

INFILCO
INCORPORATED
325 WEST 25th PLACE • CHICAGO 16, ILL.

HE'S IN GASKETOPIA!

That's the particular heaven of a man with perfect confidence that his boiler and flange gaskets are tight and leakproof—secure for long service even under the toughest operating conditions. His assurance is confirmed by the experience of marine and stationary-power men from coast to coast who specify AJAX Spiral Wound Gaskets for steam pressure applications up to 2500 psi.

AJAX Gaskets are designed and constructed by men who have specialized in gasket-engineering for over a quarter century. Here are simple construction facts:

A single strip of metal is preformed into a U-shaped groove and wound spirally from the inside to the outside. Two parallel thicknesses of UGASCO Asbestos filler are inserted between each metal ply. A functionally important air space between each of these thicknesses of asbestos makes AJAX "the gasket that breathes". Gaskets for varying pressure conditions are wound within a set OD and ID. This metal-asbestos spiral wound construction has extended the effective service life of AJAX beyond that of an ordinary gasket.

AJAX Spiral Wound Gaskets are worth specifying. When you see "United States" or "Ajax" on your gaskets it's like seeing "Sterling" on your silver. Write for Catalog 202 today.

Distributors in Principal Cities ★ ★ *A few choice industrial territories are open*

U. S. GASKET CO.

1592 PIERCE AVENUE, CAMDEN, NEW JERSEY

★ **"THE STORY BEHIND THE GASKET THAT BREATHES"**

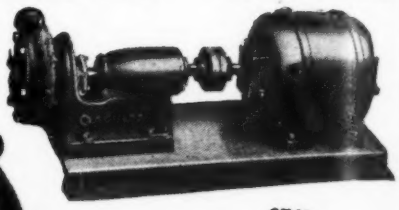
Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meat in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions — and retains the positive, secure seal you require at all times.

The above cutaway is the AJAX SR Compression Gauge Flange Gasket

From 10 GPM to 15,000 GPM



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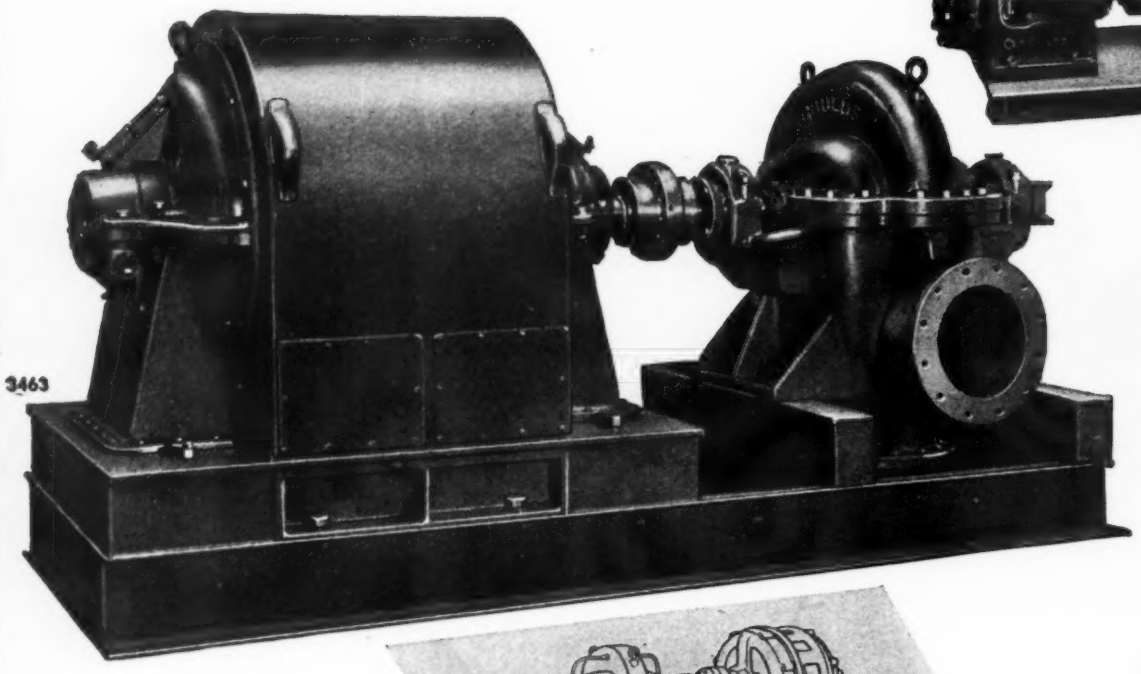

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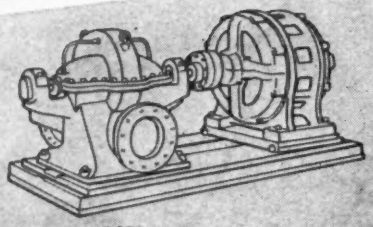

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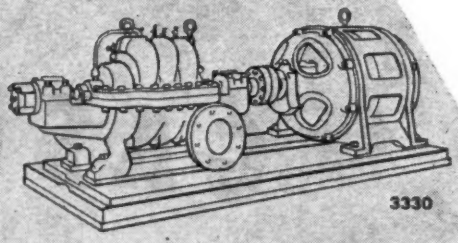

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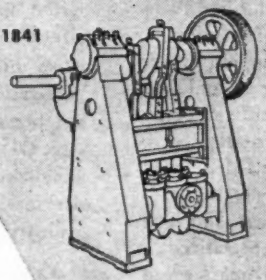

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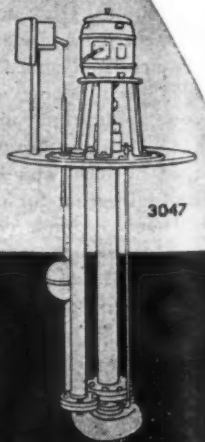


3047

You can't use the same pump to deliver 15,000 gallons per minute that you would use to deliver 10 gallons per minute. But from the Goulds complete line you can get the pump to meet your requirements in capacities anywhere between that wide range. And the pump that will lift against a head of 10 feet can certainly not be used where pressure heads are 3200 feet. But here again in the Goulds complete line will be found the pump for that duty.

Boiler feed service may be one requirement, another may be sump service, or any other of the many duties in a power plant. No matter what the service, there is a Goulds Pump to meet that requirement.

Goulds 96 years in pump building experience covers practically every branch of American Industry where liquids and semi-solids are handled. Because Goulds builds centrifugal, rotary and reciprocating pumps in a wide range of sizes and in various materials of construction depending upon the service, Goulds engineers can give you *the* Pump for *the* job. Consult Goulds on your reconversion requirements.

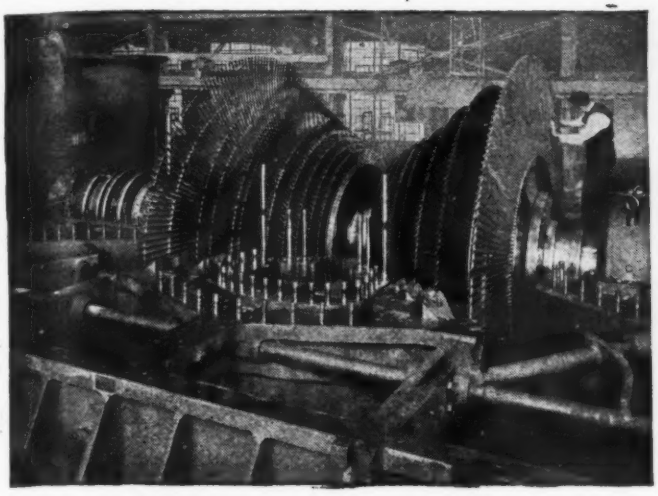
GOULDS PUMPS, INC.
SENECA FALLS, NEW YORK

Goulds

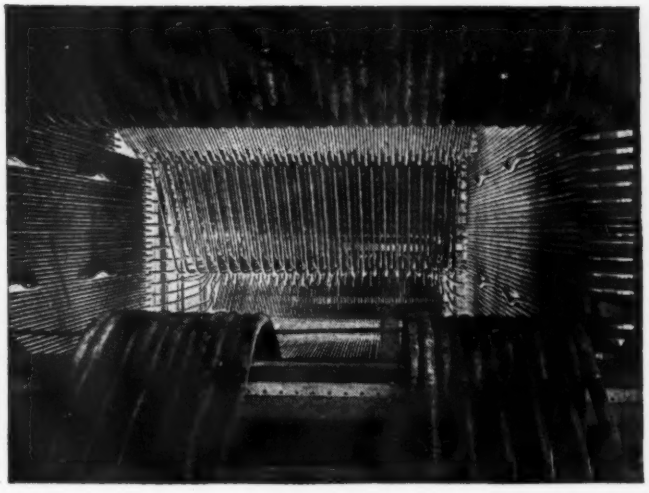
the PUMP FOR the JOB

How Chromium Steels and Irons

meet power plant requirements



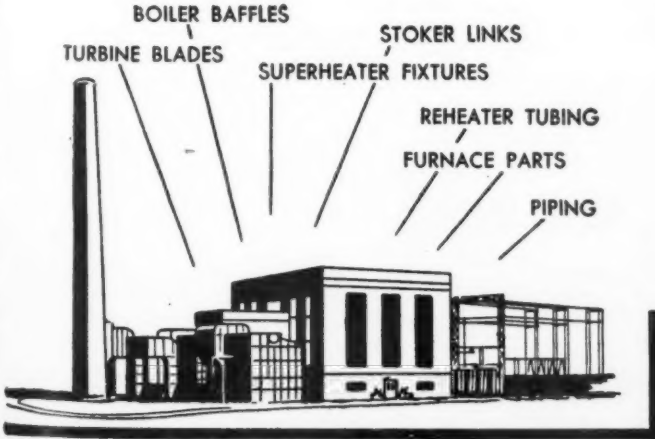
Turbine blades resist corrosion and erosion when made of stainless steel.



In this high-pressure, high-temperature boiler, connection superheater tubes are 4 to 6 per cent chromium.

● Chromium irons and steels for such parts as superheater tubes, steam pipes, turbines, furnace parts, and other power plant equipment help to give efficient, trouble-free performance. Steels containing from 4 to 6 per cent chromium and 0.5 per cent molybdenum, for instance, have good resistance to scaling and creep. The 18-8 chromium-nickel stainless steels have high strength and resistance to corrosion and oxidation. Higher chromium steels have good resistance to oxidation at high temperatures. Chromium cast irons resist wear and growth even when repeatedly heated and cooled. The illustrations show a few applications which may suggest where you can use chromium irons and steels to advantage.

We do not make iron or steel of any kind, but we have for over 38 years produced Electromet ferro-alloys used in making iron and steel. With the knowledge accumulated from this experience, we are in a position to give you impartial assistance in the selection of a chromium iron or steel to suit your particular needs.



"Electromet" is a registered trade-mark of Electro Metallurgical Company

ELECTRO METALLURGICAL COMPANY

Unit of Union Carbide and Carbon Corporation

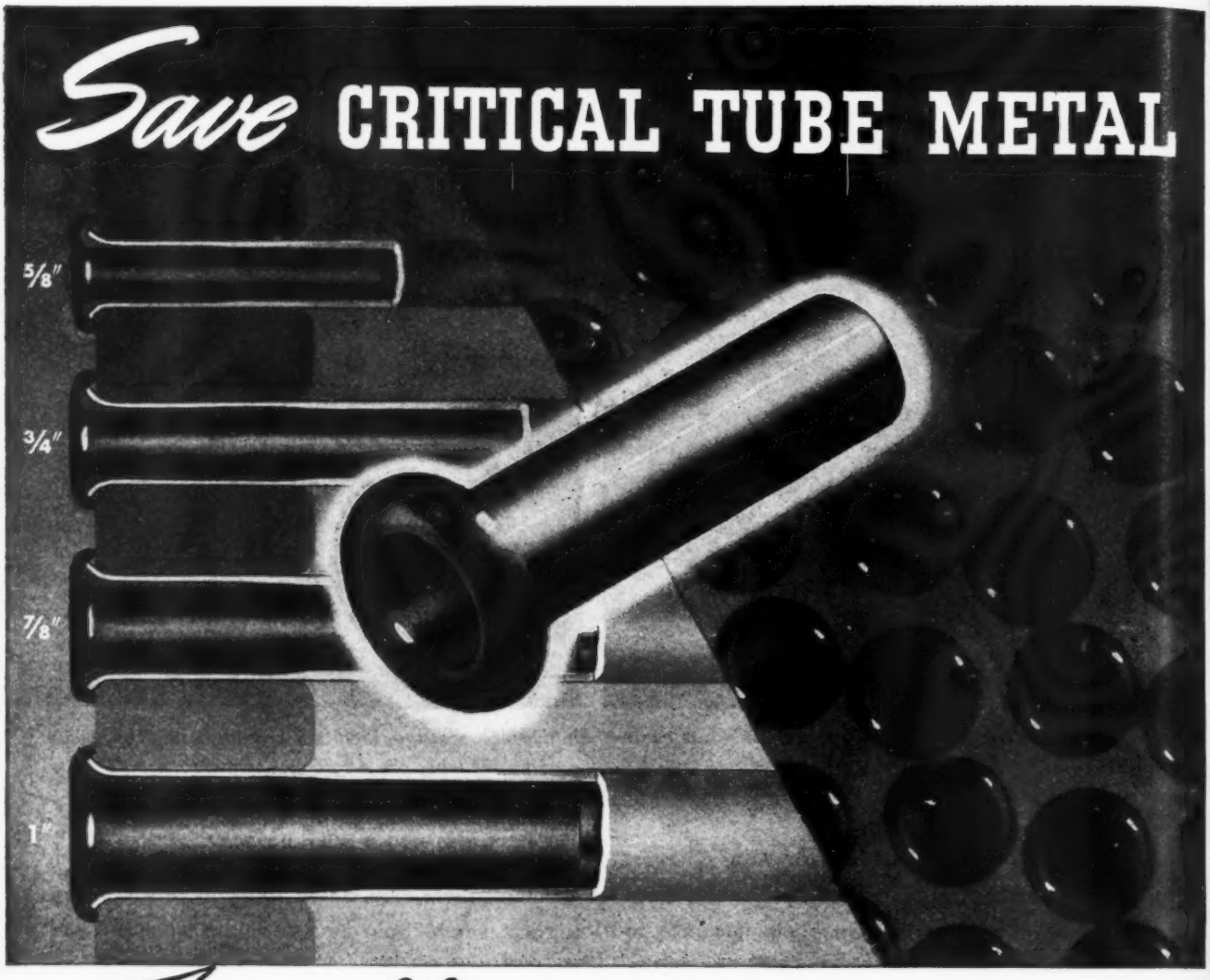
30 East 42nd Street UCC New York 17, N. Y.

In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

BUY UNITED STATES WAR BONDS AND STAMPS

Electromet
Trade-Mark
Ferro-Alloys & Metals

Save CRITICAL TUBE METAL



Install JOHN CRANE
CONDENSER TUBE PROTECTORS

The inlet end of the condenser tube is most often the first section to fail. This is the area most vulnerable to air impingement and sand abrasion. Service Tests in Marine and Stationary Condensers prove that John Crane Condenser Tube Protectors *armor the entrance section; greatly lengthen tube life.* Note these other important advantages:

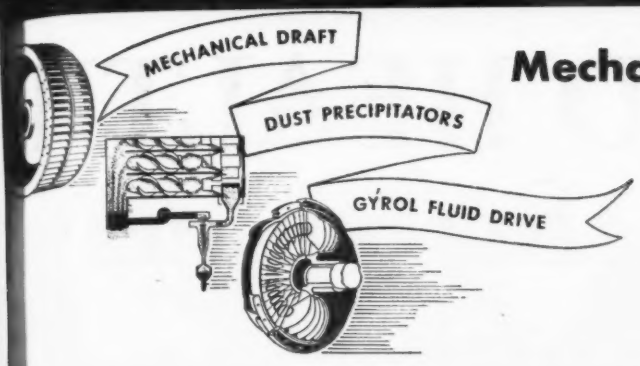
- **Molded of a hard, wear-resistant plastic material**
- **Resist contaminated salt or fresh water**
- **Unaffected by temperatures to 275° F.**
- **Provide a belled mouth for inlet tube ends; reduce turbulence**
- **Easily installed on both old and new tubes**
- **Last for life of tubes**

John Crane Condenser Tube Protectors are inexpensive to install; and require no special tools. Available for 5/8" and 3/4" 16-BWG, or 5/8", 3/4", 7/8" and 1" 18-BWG tubes. For full information send for *illustrated* bulletin, or consult our branch office *nearest you.*

CRANE PACKING COMPANY — 1811 CUYLER AVE. • CHICAGO 13, ILL.

BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

CRANE PACKING CO., LTD., Hamilton, Ontario, Canada.
Branches: Montreal, Toronto, Vancouver

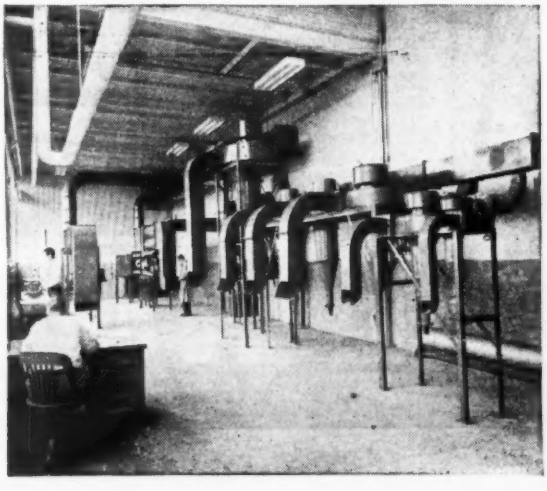


Mechanical Draft, Dust Precipitators, Fluid Drives—

BUY ALL THREE FROM A.B.C.!

Whether you are planning a fine new power plant for the postwar era, or are going to modernize your present plant, you can benefit by buying all 3 from A.B.C.! One source of technical information, far less red tape and, above all, undivided responsibility are yours when you select American Blower Mechanical Draft Fans, Dust Precipitators and Gyrol Fluid Drives for your plant. Phone or write the nearest American Blower Branch Office today.

HERE IS A PART of our complete Dust Testing Laboratories. Equipment is readily available to run every conceivable type of dust test. In the last 20 years, more than 4,100 distinctly different materials have been tested in these laboratories and results carefully filed in our "Library of Dust." If you have a fly ash problem, send your samples to us. We'll run tests, determine the best equipment suited to your individual needs. Remember, every Dust Precipitator and Dust Collector we sell is built entirely in our own plants, and designed to meet the requirements of the individual job it is to do. Your inquiries are invited. There is no obligation.



AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

Here's GOOD HEALTH for boilers

For curved tubes a short-bodied 1300 series motor is used with universal joint between motor and Quick Repair head and a short length of hose at the rear to give flexibility.

●

Write today for the Elliott boiler tube cleaner bulletin. If you have an unusually tricky or difficult tube cleaning problem, consult with the nearest Elliott specialist. We will put you in touch.

The 1300 series motor connected to Type PN cutter head for 3" straight tubes

Cleaner for 3½" curved tubes, 1300 series motor and Type H2 head with universal coupling, short length of hose at rear of motor.

1300 series cleaner for 3" curved tubes with universal joint and drill, short length of hose connected to rear of motor.

1300 series motor equipped with vibrator head for use in removing scale from the outside of fire tubes.

Elliott 1300 series tube cleaners are the speedy remedy for that tired feeling in scaled up boilers.

They have *power*—plenty of it, to drive cutter heads in a smashing attack on the toughest scale, at all the speed required to get a complete cleaning job in a *single pass* through each tube. No need to run the motor while the cleaner is being returned through the tube—simply haul it back and get going on the next tube without delay.

Elliott 1300 series cleaners have everything that years of veteran experience can supply to make the tube cleaning job easier, faster, more thorough.

Avoid that "tired feeling" in your boiler room personnel, too. Tube cleaning is a chore—but its unpleasant features can be greatly reduced. These Elliott 1300 series cleaners are proving it every day.

ELLIOTT COMPANY
TUBE CLEANER DEPT., SPRINGFIELD, O.
District Offices in Principal Cities
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.

Y-241

ELLIOTT 1300 SERIES TUBE CLEANERS

AS CHIEF ENGINEER, VALVE FAILURES ARE MY BUSINESS

. . . I've found Dexter is good Business!

We can't shut down power plants and cut off our steam, air, oil and water lines when production schedules are crowded as they are now. And we don't have a whole crew available to take out and replace leaky valves . . . even if we could get replacements.

So we put in a Dexter Valve Reseating outfit, and now one man can reseat a valve, right on the line in a few minutes.

At our plant the wheels must keep turning and we've found that the Dexter Valve Reseating outfit can help make that possible.

23

A large part of our production facilities is devoted to war work. Orders for Dexter Machines and Cutters, from firms who want this economy and efficiency, have far exceeded our non-military manufacturing facilities. Please be patient — we will deliver just as quickly as possible.

WE'LL ANSWER PROMPTLY

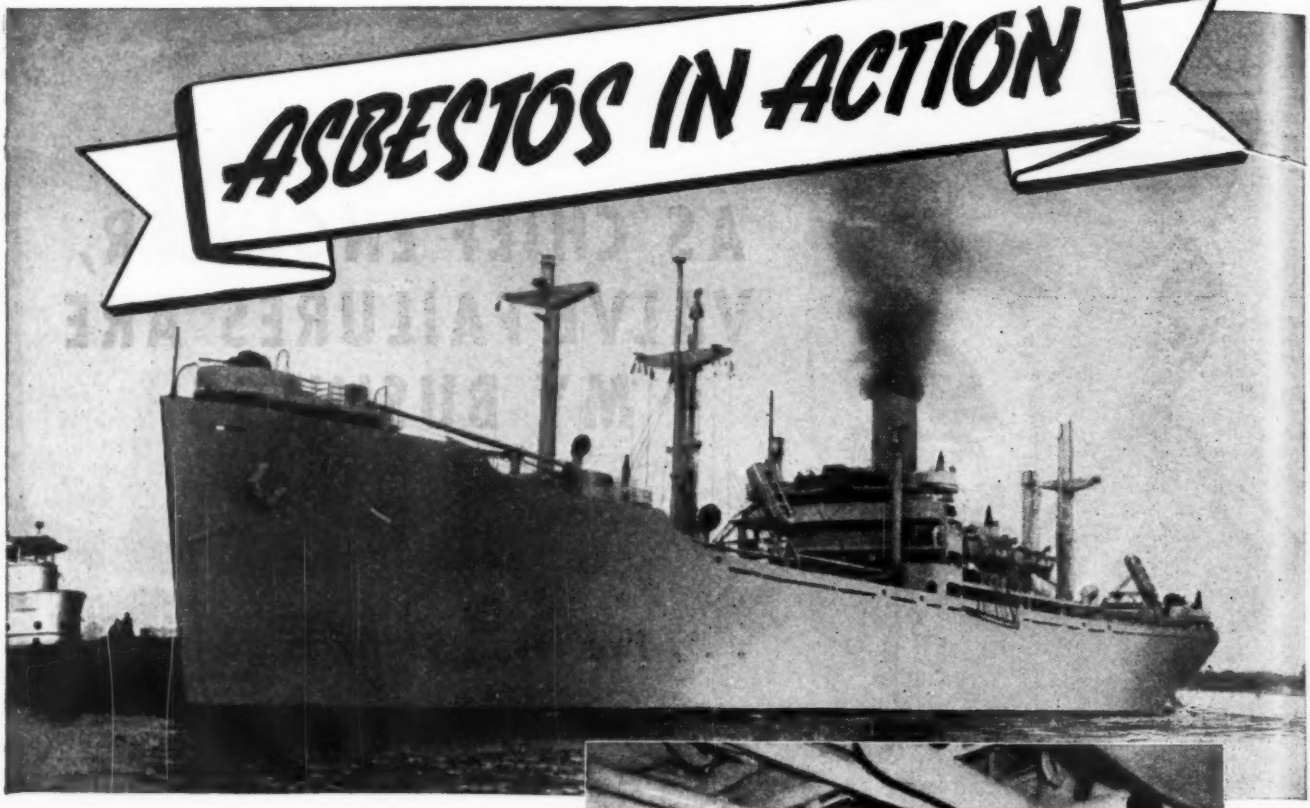
your inquiries about valve problems. Tell us your toughest valve-leak story. Please include full data.

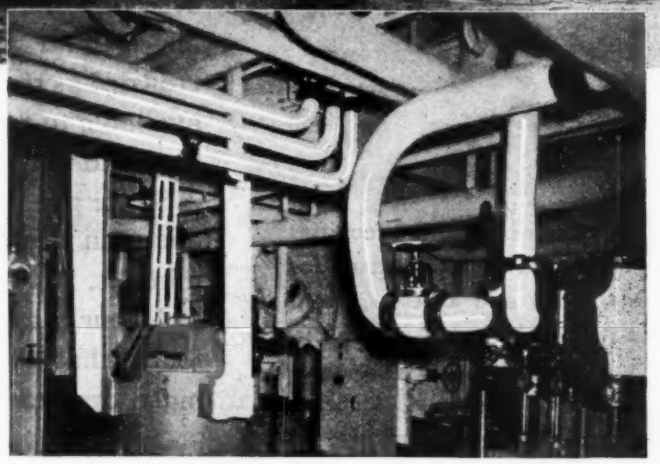
●

DEXTER VALVE RESEATING MACHINES AND CUTTERS for Globe, Gate and Pump Valves

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

ASBESTOS IN ACTION





Saving precious fuel and steam

K&M "FEATHERWEIGHT" 85% *Magnesia*

"Photo Courtesy Armstrong Cork Company"

Every intricate bend of the steam piping to pumps and apparatus in the engine room of this cargo vessel is tailored uniformly with K&M "Featherweight" 85% Magnesia. This widely used pipe covering combines the high insulating properties of basic Carbonate of Magnesia with strong Asbestos Fibres, and is designed for pipes carrying temperatures up to 600° F. It is extremely light in weight and it delivers maximum efficiency.

In one shipyard alone, 250 cargo vessels of the Liberty and faster 16 knot Victory type (pictured above) have been insulated by the skilled coverers of the Armstrong Cork Company, distributors of K&M "Featherweight" 85% Magnesia.

K&M "Featherweight" 85% Magnesia is giving this same kind of dependable service—these same heat and fuel savings—in power plants and industrial process plants all over the country. In fact, from the time 85% Magnesia Insulation was first developed by K&M more than sixty-five years ago, the name "Featherweight" has been a byword for quality with plant operating men.

ARMY E NAVY

K&M best in asbestos

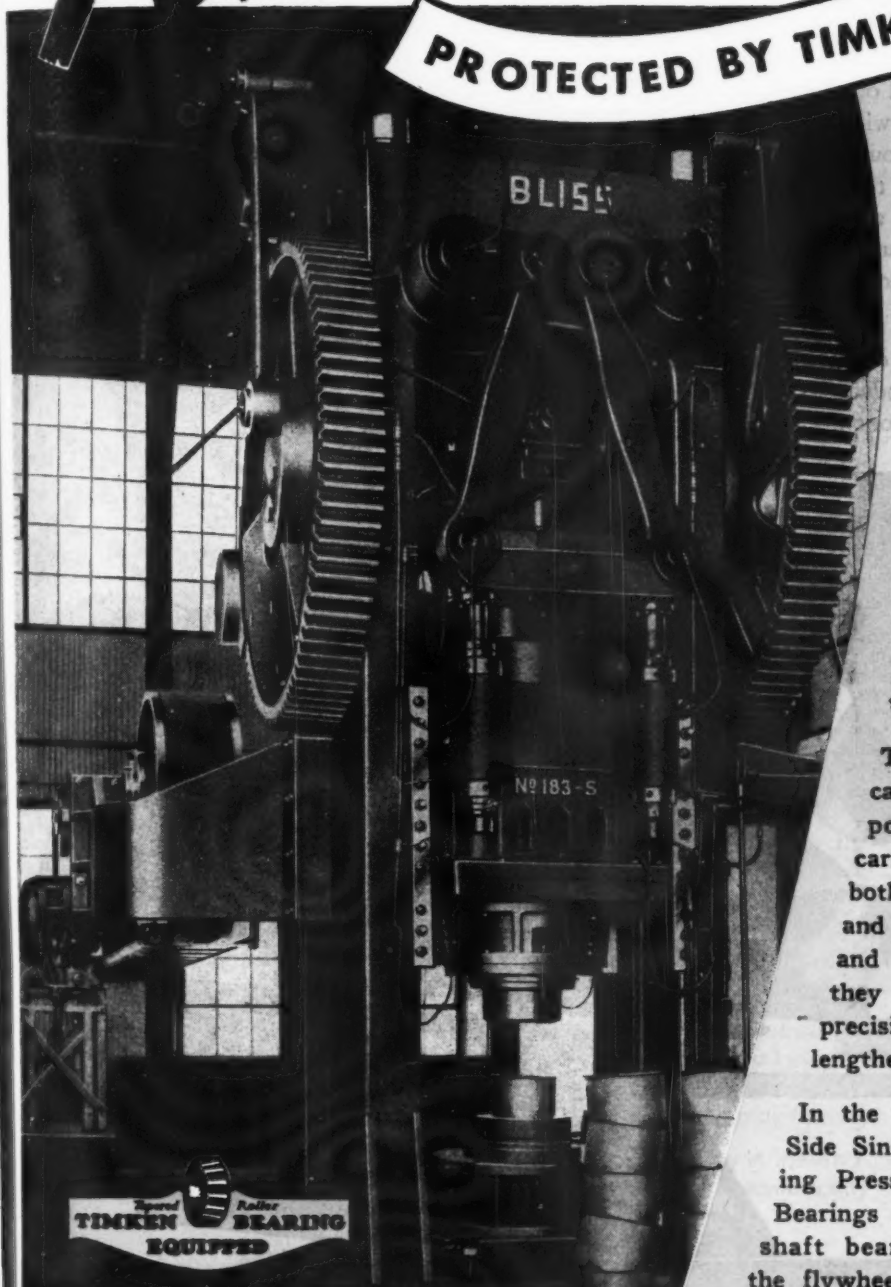
YOUR MERCHANT MARINE SAVED US DURING WAR—LET IT SERVE YOU DURING PEACE

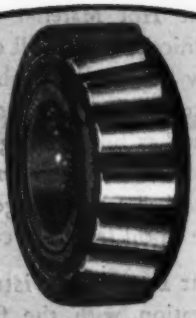
KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

Power for the deep draw

PROTECTED BY TIMKEN BEARINGS





There's no percentage in using more power than is necessary to do the job in any kind of machine. Recognizing this, thousands of equipment manufacturers use Timken Tapered Roller Bearings to economize power by preventing loss through friction.

They use Timken Bearings because, in addition to saving power, these bearings safely carry all loads—radial, thrust, or both together in any combination; and hold moving parts in correct and constant alignment. Thus they help to increase operating precision; add endurance; and lengthen machine life.

In the No. 183-S Bliss Straight Side Single Crank Toggle Drawing Press pictured here, Timken Bearings are applied at all driveshaft bearing positions and in the flywheel — 8 bearings in all. They are also used in other models of Bliss Presses; have been for years. The E. W. Bliss Company has proved they pay—and so have their customers. Quality is assured when the trade mark "TIMKEN" appears on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE MARK REG U S PAT OFF

TAPERED ROLLER BEARINGS

Science IMPROVES REPUBLIC BELTING AND HOSE

THIS IS a new age of rubber—man-made rubber—an evolution to greater things. Republic technologists have developed many mechanical rubber products into greater and longer usefulness than ever.

With reinforced compounds of heat-and-oil-resisting synthetic rubber, Reprene Hot Material Conveyor Belting is built to handle coke, clinkers, chemicals, sugar mill char and other materials and by-products up to 250° F. New flexibility and ability to withstand oily and greasy operating conditions make Challenger Reprene an outstanding transmission belt. Republic Steam Hose has been re-engineered to resist specific pressures and temperatures, and Tower Air Hose has a new ruggedness and higher resistance to oil from the compressor.

Your Republic Distributor, working in cooperation with the factory, can recommend these and other improved products to you for longer service and greater economy.

Better Than Before

WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

REPUBLIC RUBBER

DIVISION

LEE RUBBER & TIRE CORPORATION

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REPUBLIC INDUSTRIAL PRODUCTS
YOUNGSTOWN, O

LEE DELUXE TIRES AND TUBES
CONSHOHOCKEN, PA.

The bulletins shown are typical of the engineering service Falk renders to industry.

The Phrase FALK ... A GOOD NAME IN INDUSTRY Possesses Tangible Values For You!

The individual sale of a product is incidental. The service which that product renders is all-important . . . All-important to the buyer, because the continued satisfactory performance of that product confirms his judgment in purchasing it . . . All-important to the seller, because the satisfaction rendered the buyer enables the manufacturer to make sale after sale.

Falk products have been rendering a satisfactory service to industry for over 50 years. It is this satisfactory service that has enabled The Falk Corporation to continue, and to progress. It has enabled the buyer to depend on Falk claims for its products, and to depend on the performance to be secured from those products.

This is what we imply when we say: "Falk . . . a Good Name in Industry." That phrase includes the Falk philosophy of doing business, its policies, its research, its engineering skills, its production facilities, its service to industry, to its community, and to its employes. All this has given the Falk name a tangible value; and this tangible value has been meticulously maintained.

You who buy Falk products have acclaimed Falk a good name in industry. The fact that you were jointly responsible for this good name automatically provides you with values that would not otherwise be available.

Therefore we say "Falk . . . a Good Name in Industry" possesses concrete value, and carries the assurance that "it always pays to consult Falk."

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For over fifty years
Precision Manufacturers of
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Marine and Diesel Engine Gear Drives and Clutches • Steel Castings • Contract Welding and Machine Work.

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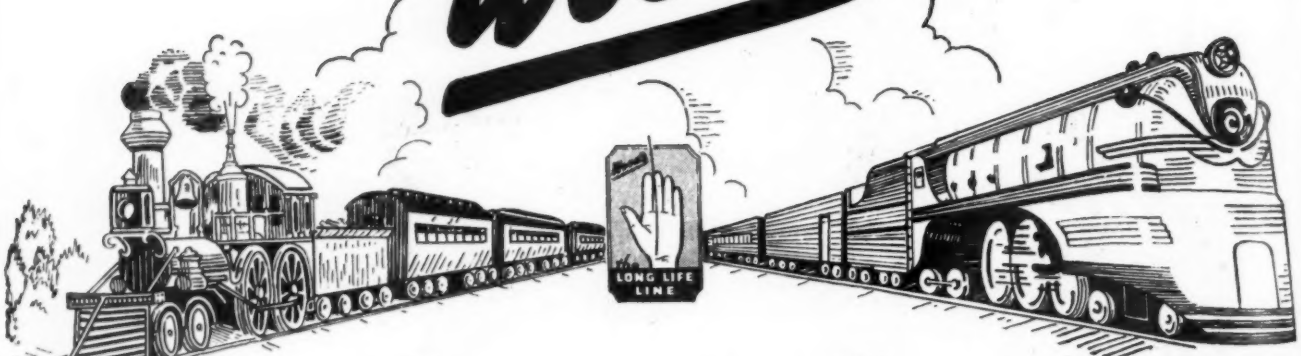
Wood's



...Spans the Years

WHEN your grandfather journeyed down to Washington for Lincoln's inauguration, he rode by many a mill and shop in which Wood's transmission equipment was turning the wheels of lusty, growing American industry

Today, streamliners speed past gigantic, modern industrial plants where Wood's V-Belt drives aid in mass production... the eighth wonder of the world. Wood's products have stood the test of time.

Since 1857 this complete line of transmission equipment—with an earned reputation for excellence—skillfully designed and efficiently manufactured, has been a dependable stand-by of industry.

Wood's V-Belt drives, backed by Wood's experience, and gauged both by built-in quality and reliable performance, represent outstanding value in the field.

Wood's V-Belt drives render trouble free service...provide inherent day-in and day-out reliability at a low figure for maintenance.

Wood's V-Belt drives and other products of Wood's manufacture will serve you faithfully in the post war era. Plan for post war now. Engineering consultation welcomed. Details furnished upon request—or see your conveniently located Wood's dealer.

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Bearings—Collars—Clutches—Couplings—Contactors —Hangers—Pillow Blocks—Pulleys—V-Belt Sheaves and Complete Drives

T. B. WOOD'S SONS COMPANY, CHAMBERSBURG, PENNA.

Branches: Boston, Mass. Newark, N. J. Pittsburgh, Pa. Cleveland, Ohio Detroit, Mich. Houston, Texas

Where Heat, Flame, Oil, Moisture, Grease and Corrosive Vapors will be encountered — —

Use NATIONAL ELECTRIC ASBESTOS AND ASBESTOS-VARNISHED CAMBRIC WIRES AND CABLES

For temperatures higher than permissible limits for rubber, NE\on (thermoplastic) and varnished cambric insulations, we recommend National Electric asbestos, asbestos-varnished cambric and asbestos—NE\on (thermoplastic) insulated wires and cables. Complete engineering data and literature sent on request.

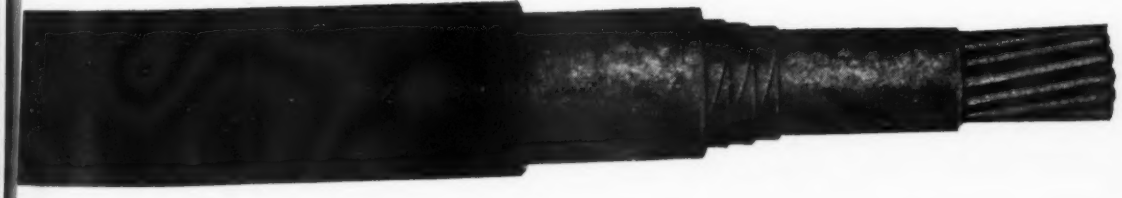
NATIONAL ELECTRIC PRODUCTS
NE
WIRING SYSTEMS 6
WIRES AND CABLES

ALL ASBESTOS WIRE AND CABLE

Sizes No. 18AWG to 1,000,000 CM.—For wiring rheostats, stoves, switchboards and electrical equipment exposed to heat or fire hazard. Also for general open wiring in hot locations. 300 and 600 volt ratings. Max. operating temperatures 200°C (392°F) and 125°C (257°F) respectively.

ASBESTOS-VARNISHED CAMBRIC CABLE

Sizes No. 18AWG to 1,000,000 CM.—For power circuits and general hot spot wiring in boiler rooms, steam tunnels, etc. 600 to 8000 volt ratings. Max. operating temperatures 110°C (230°F) and 91°C (196°F) respectively.



National Electric
PRODUCTS CORPORATION
Pittsburgh, Pa.

"Wonder what our competitors pay for power..."

YOU don't have to worry about steam production costs if *your* boilers are fired by TODD burners. Why let inefficient boiler room equipment waste precious fuel today—and cut down your profits when competition gets tough again? Get the jump on power costs *right now*—by modernizing with TODD oil and gas burning equipment.

Industrial and commercial plants all over the country have already installed modern automatic TODD burners. Today these plants are producing *more power*—with up to 10% *less fuel.* Even larger fuel savings are frequently reported.

TODD combustion engineers are old hands at modernization. Call on them at any time—without obligation—for an impartial survey of your plant, and for suggestions, specifications, estimates. Let them show you in terms of dollars and cents why NOW IS THE TIME TO MODERNIZE WITH TODD.

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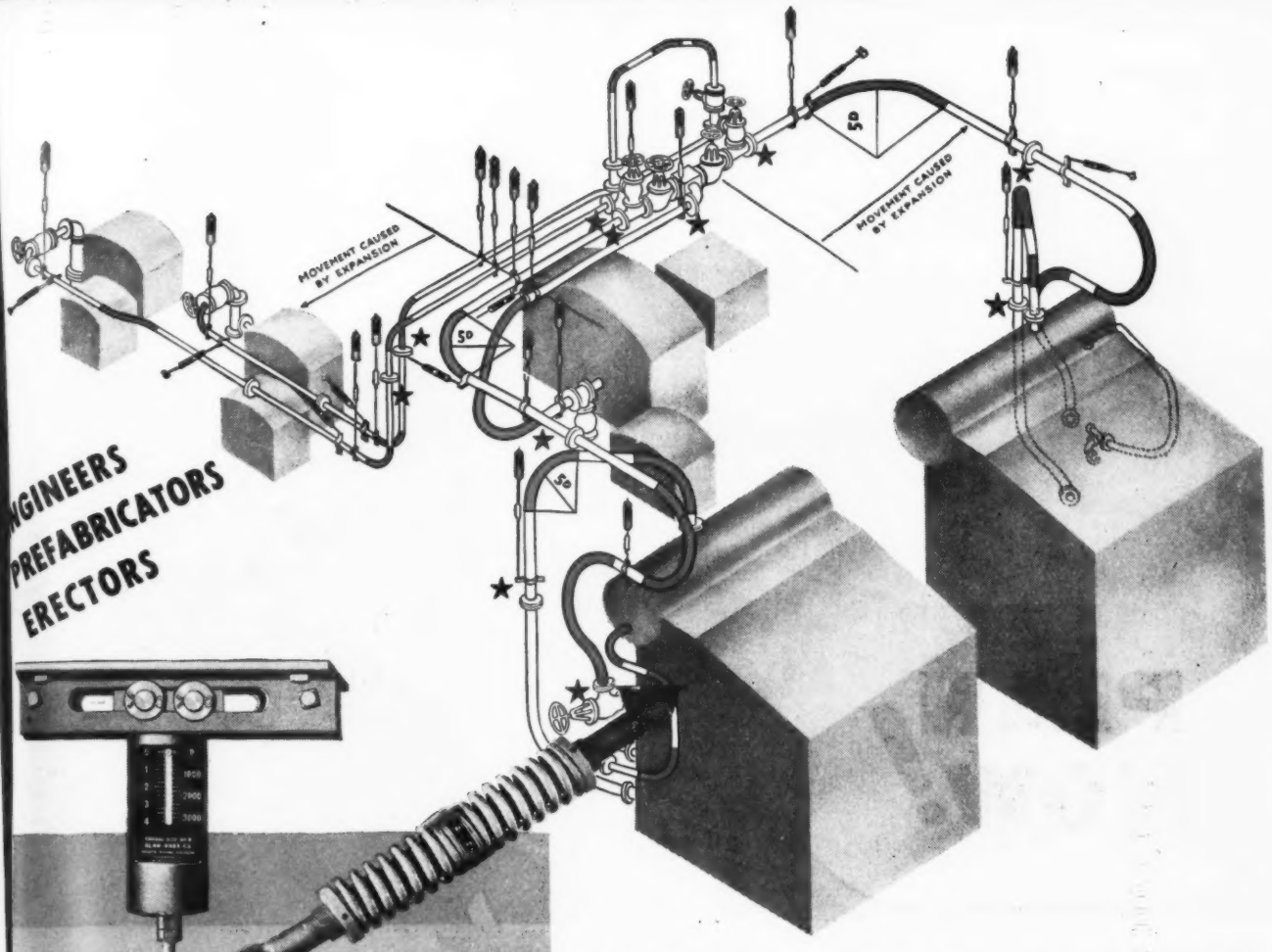
NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, BARBER, N. J., PHILADELPHIA, SO. PORTLAND, ME., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, CHICAGO, GRAND RAPIDS, TAMPA, GALVESTON, HOUSTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, TACOMA, MONTREAL, TORONTO, BUENOS AIRES, LONDON

ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT



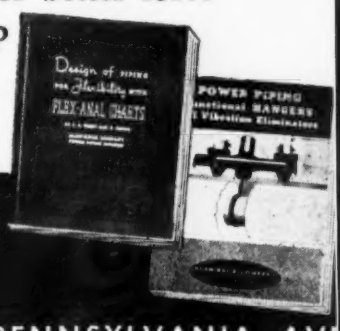
NGINEERS
PREFABRICATORS
ERECTORS

BLAW-KNOX PIPING INSTALLATIONS

Have These 5 Distinct Advantages

1. Reduction in number of joints
2. Joints located in zone of lowest bending movement
3. More desirable steam flow characteristics
4. Savings of lineal feet of pipe
5. Purposely designed for better force and stress relationship

These two books constitute a service offered by Power Piping Division for the benefit of the engineering fraternity and will be sent FREE to any engineer requesting them on his business letterhead.



AW-KNOX COMPANY
OWER PIPING DIVISION
1525 PENNSYLVANIA AVE
N. S., PITTSBURGH, PENNA

FOR Postwar AIR CONDITIONING

PRECISION manufacturing and processing, as well as employee comfort will be just as important after the war as it is now — probably more so, for competition will be keener. Now is the time to plan for the air conditioning installation you want. This will eliminate possibility of delay and will help you to quickly change back to peacetime production . . . Minneapolis-Honeywell engineers have developed many improvements which will benefit you. They will be glad to work with you, your architects, or your heating engineer on your postwar plans, without cost or obligation . . . Minneapolis-Honeywell Regulator Co., 2702 Fourth Avenue S., Minneapolis 8, Minnesota. Branches in 49 cities.

Buy More War Bonds!

INSTRUMENTS BY **BROWN** FOR INDUSTRY
MINNEAPOLIS-HONEYWELL
TEMPERATURE CONTROLS

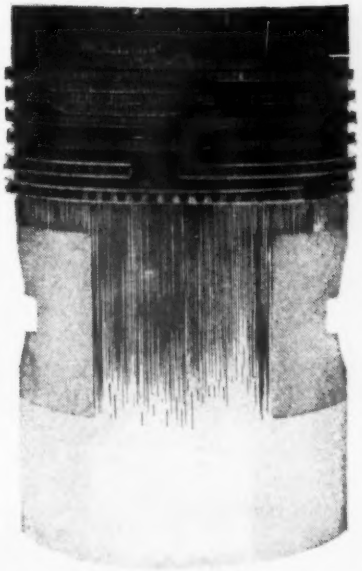
How RPM DELO Oil reduces engine wear

NEW PISTON RING

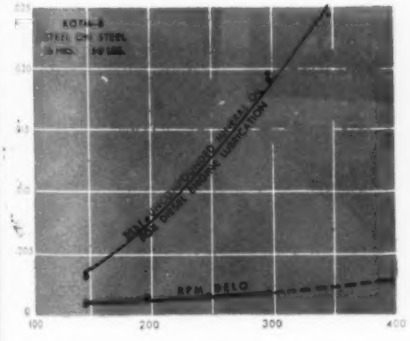
SCRATCHING WITH UNCOMPOUNDED MINERAL OIL

RING USED WITH RPM DELO OIL

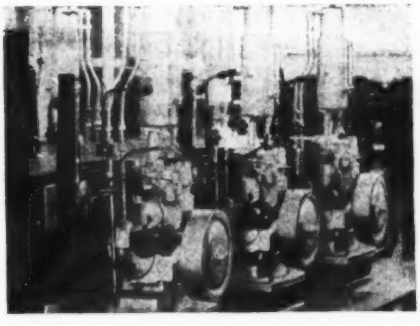
The actual photographs above, in which the lines are merely emphasized by printing in red, are typical of the results obtained when testing RPM DELO Diesel Engine Lubricating Oil against ordinary Diesel oils. Because RPM DELO Oil contains a patented metal-adhering compound, it clings to hot cylinder spots that other oils leave dry, protecting rings and liners against excessive wear.



Here is a piston used in a special break-in test with straight mineral oil. This actual photo, with scratches emphasized in red, shows how rings, lands and skirt are badly scratched.



Confirming actual tests in engines are such laboratory tests as this with a Kinetic Oiliness Testing machine. RPM DELO Oil has far lower wear rate than the best uncompounded oil.



Here is a battery of special test engines in California Research Corporation's laboratories. They are used to determine the anti-ring-sticking properties of oils.

This piston went through the same test as the one above—but with RPM DELO Oil. No scratching occurred and every ring is free. RPM DELO Oil's film prevents scratching and scoring.

Detergent compound to clean engine.

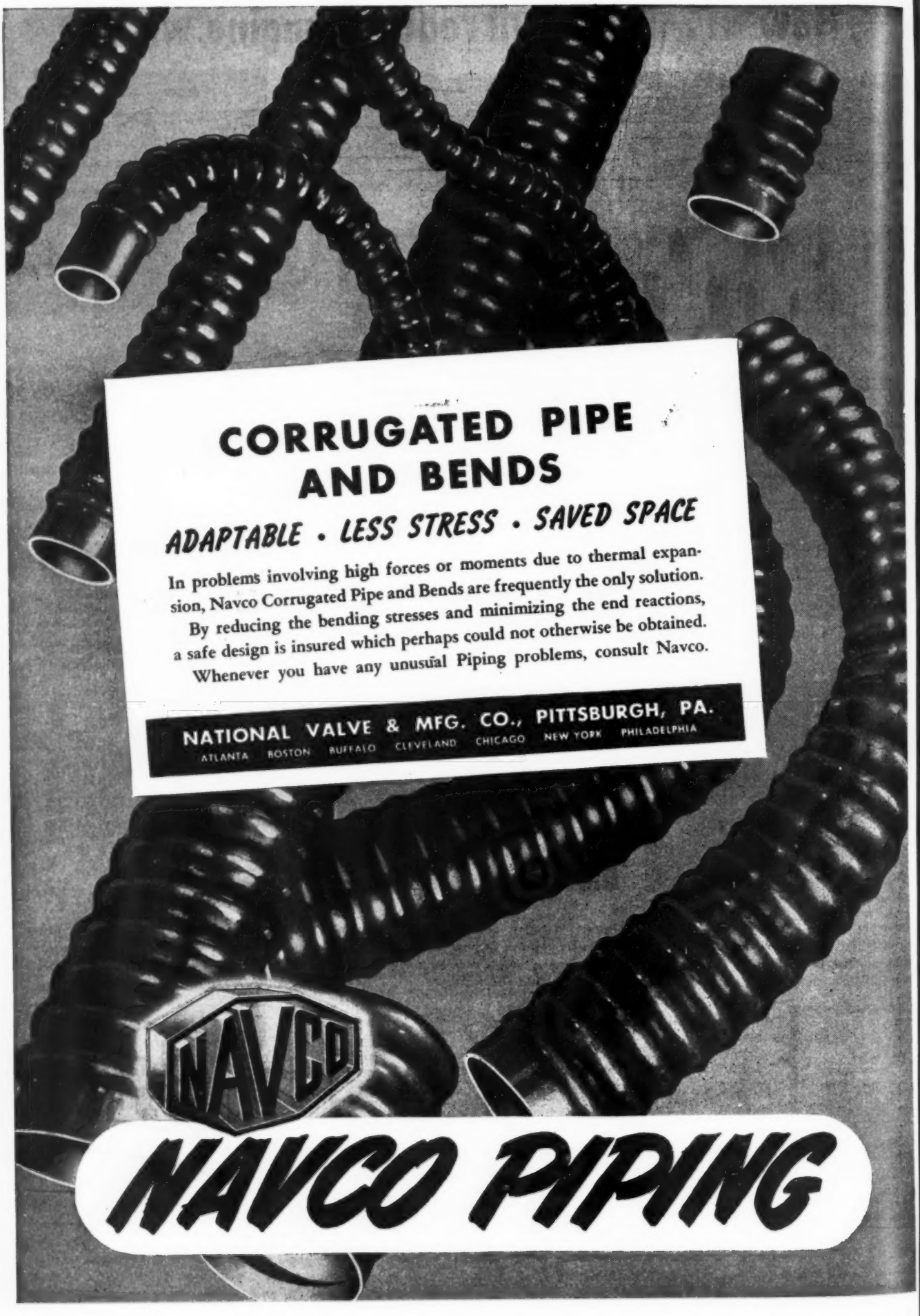
Anti-oxidant to prevent gum and sludge.

Wear-reducing compound.

STANDARD OF CALIFORNIA

RPM DELO Oil has world-wide distribution, marketed under following names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Sohio RPM DELO, Imperial RPM DELO (CONCENTRATE)

For more technical information about this revolutionary Diesel Engine lubricating oil, write to Standard of California, 225 Bush St., San Francisco 20, California, or California Commercial Co., 30 Rockefeller Plaza, New York 20, N. Y.


CORRUGATED PIPE AND BENDS
ADAPTABLE • LESS STRESS • SAVED SPACE
In problems involving high forces or moments due to thermal expansion, Navco Corrugated Pipe and Bends are frequently the only solution.
By reducing the bending stresses and minimizing the end reactions, a safe design is insured which perhaps could not otherwise be obtained.
Whenever you have any unusual Piping problems, consult Navco.
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ATLANTA BOSTON BUFFALO CLEVELAND CHICAGO NEW YORK PHILADELPHIA
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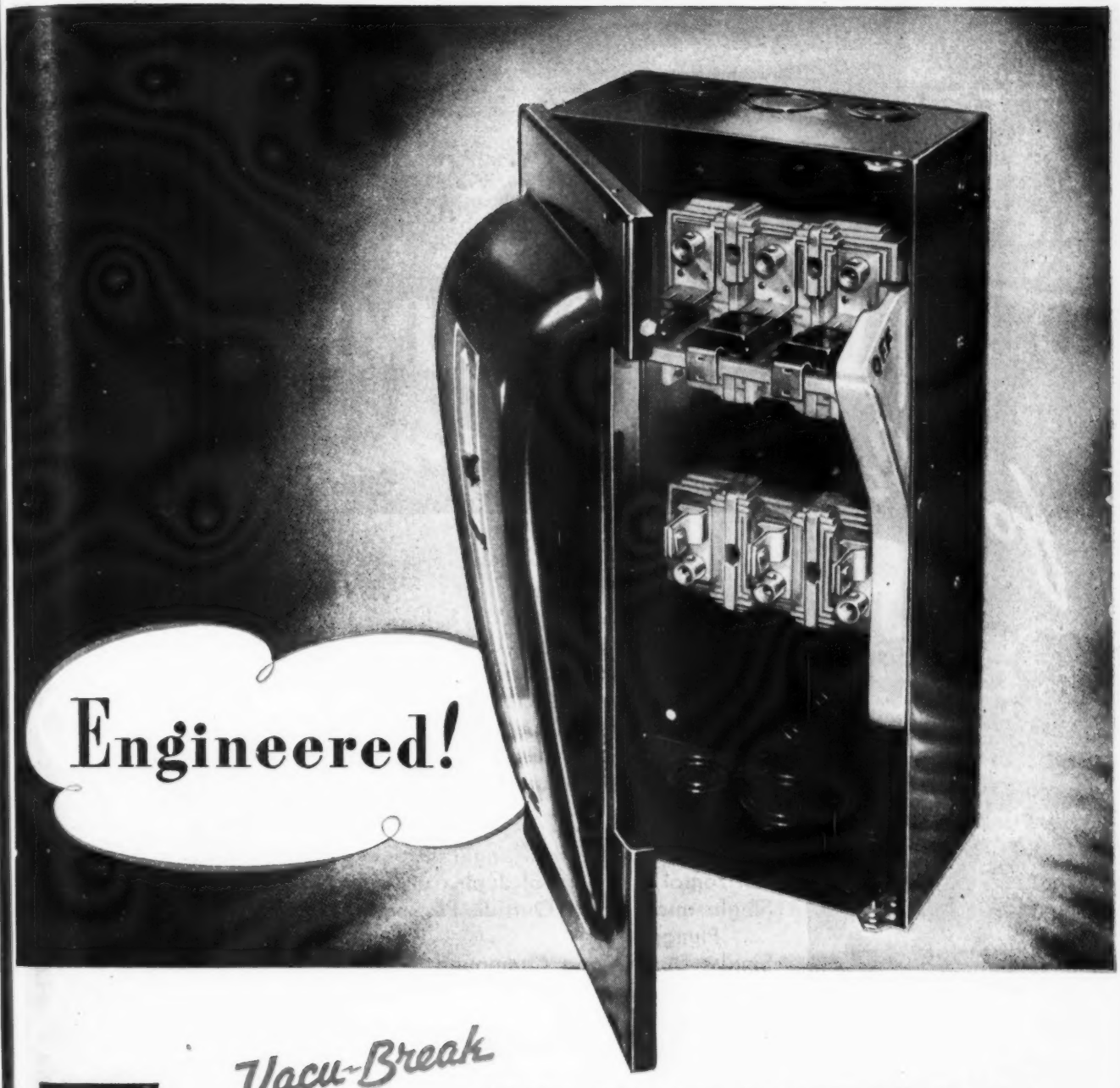
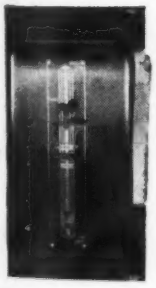


Engineered!

Vacu-Break



SAFETY SWITCH WITH "CLAMPMATIC" CONTACTS

BullDog technicians put in years of laboratory research to develop these advanced principles in safety switch design—more years of experimental engineering to *prove* them. Result: The BullDog Vacu-Break Safety Switch—far ahead of the field!

No other safety switch has the Vacu-Break principle of arc suffocation—Clampmatic contacts tight as a bolted connection in the *ON* position, thus reducing heating—simplified mechanism for positive operation—modern streamlined cabinet—ample interior wiring space without sacrificing over-all compactness. Capacities from 30 Amp. to 1200 Amp.

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SALVAGE PAPER

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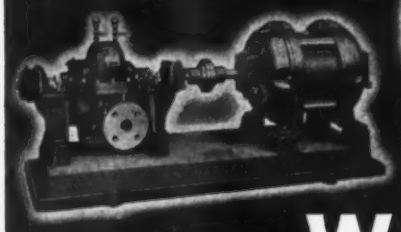
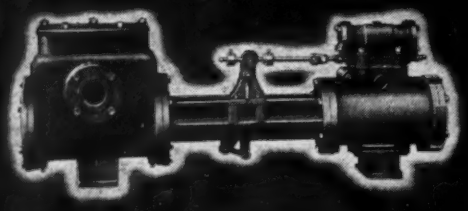
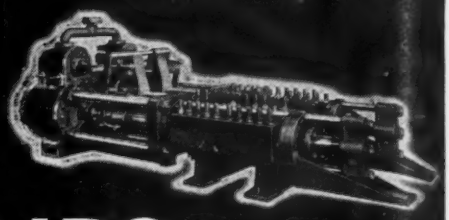
Warren Two-Stage Volute Centrifugal Pump





Warren Steam Heat Vacuum Pump

Warren Horizontal Duplex Hydraulic Pump



WARREN PUMPS

for Post-War Planning Include:

Warren Type "L" Single-Stage Single-Suction Liquor Pump

CENTRIFUGAL

Single and multi-stage
Pressure range: 0 to 850 P. S. I.
Capacities: 0 to 36,000 G. P. M.
Types: Horizontal & Vertical
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Casings: Horizontal or Vertical Split, cast iron or bronze
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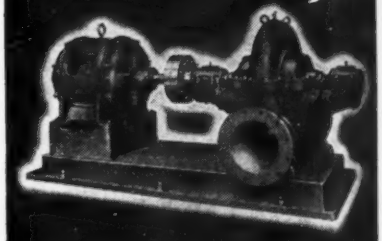
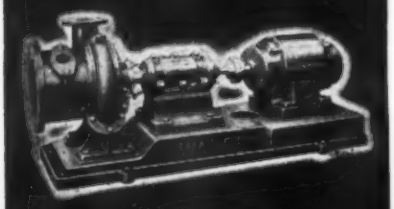
RECIPROCATING

Horizontal and Vertical single piston
Horizontal and Vertical duplex piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.

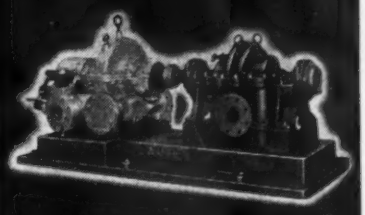
Send your pumping problem to us; our Engineers will recommend the right pump for the job.



Warren 14-in. Single-Stage Double Suction Pump



Warren Heavy Liquid Centrifugal Pump



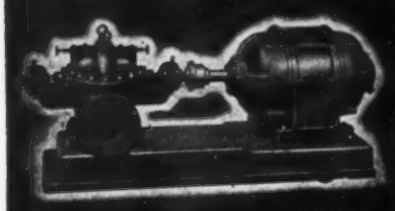
Warren Two-Stage Volute Centrifugal Pump

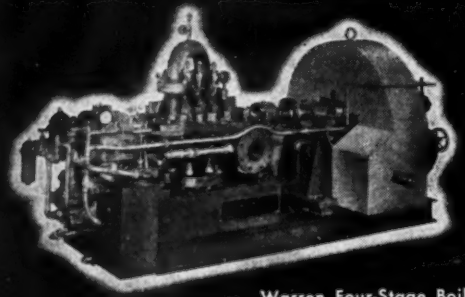
ARMY E NAVY

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

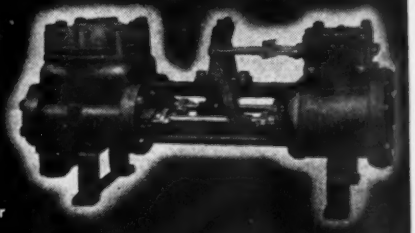
Warren Single-Stage High Speed Centrifugal Pump

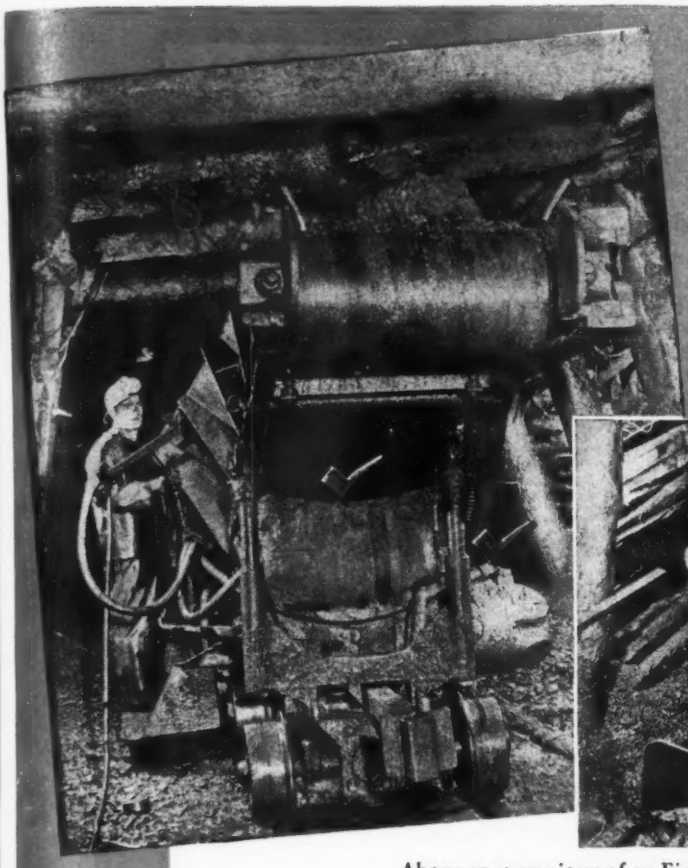


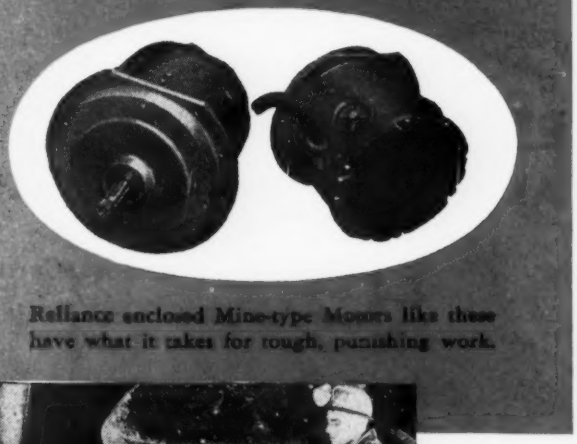


Warren Four-Stage Boiler Feed Pump

Warren Horizontal "Realwear" Duplex Piston Pump







Reliance enclosed Mine-type Motors like these have what it takes for tough, punishing work.

Above are two views of an Eimco RockerShovel. Arrows indicate locations of Reliance Motors.

Here's Where RELIANCE MOTORS REALLY TAKE A BEATING!

● Eimco RockerShovels work far underground. Their job is to scoop up the ore and rock, loosened by drilling and blasting operations, and load it into cars. It is tough, dirty, wet, bruising work, which is being handled with 100% satisfaction through use of Reliance Motors that are specially designed, both electrically and mechanically, for such duty.

Reliance Motors have proved that, in this punishing service, they can both outperform and outlast other types of motors formerly used. And Reliance installations are standing up equally well in many other tough assignments in many industries.

Whenever you have need of motors that can really take a beating—or, for that matter, whenever you need motors for any industrial use—it's a good rule to call in a Reliance Application Engineer. He's a man worth knowing.

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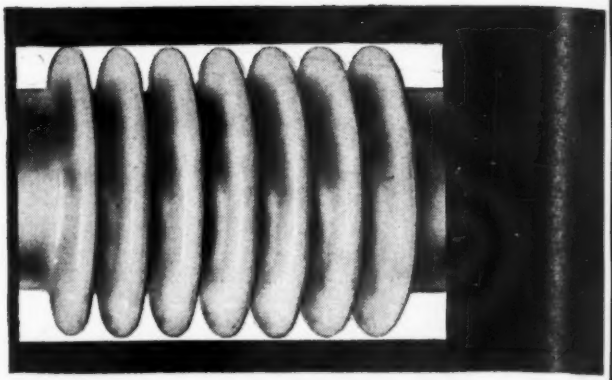
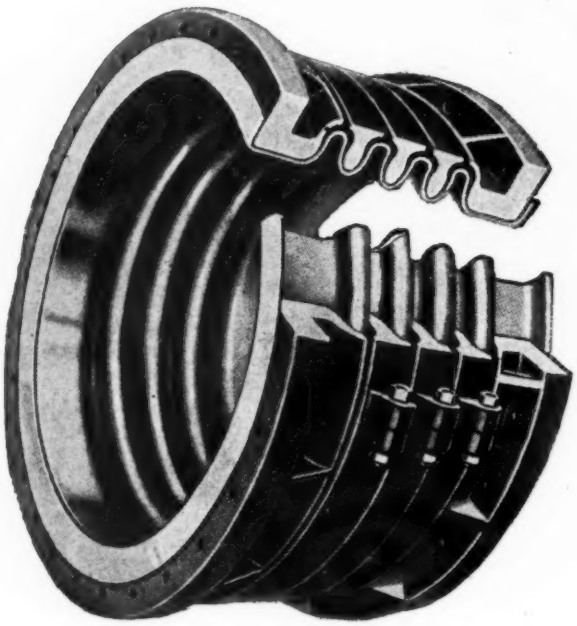
RELIANCE A·C D·C MOTORS

"MOTOR-DRIVE IS MORE THAN POWER"

DEEP ANNULAR
ALL-CURVE CORRUGATIONS

give Badger Packless Corrugated Expansion Joints more flexing area





Because Badger Joints have deep corrugations, they provide the needed expansion-and-contraction with a given number of corrugations. They are compact and easily installed. Note these further features:

ALL-CURVE CORRUGATION DESIGN facilitates the even distribution of flexing stresses over the whole contour of the corrugations . . . lengthening service life.

ALL-CURVE EQUALIZING RINGS (exclusive in Badger Joints) provide *directed flexing*. They further assure uniform distribution of stresses — not only throughout each corrugation, but also among *all* the corrugations of the joint.

PACKLESS CONSTRUCTION. Forming the joint proper from a single piece of tubing eliminates the need of packing — and, consequently, of packing maintenance (which, in underground installations, often necessitates expensive manhole and tunnel construction).

SPECIAL HEAT-TREATMENT, after forming, preserves flexing qualities — adds to the efficiency, dependability and long life of Badger Joints.

COPPER OR STAINLESS STEEL. Made in copper for normal pressures and temperatures; in stainless steel for higher requirements — and where corrosion is a problem. Single and multiple corrugations — for traverses from a fraction of an inch upward. Also made in Non-equalizing type for uses where the added protection of equalizing rings is not required.

FREE BULLETINS: ***No. 100 on Self-equalizing; No. 200 on Non-equalizing***

E. B. BADGER & SONS CO., 75 Pitts Street, Boston 14, Mass.

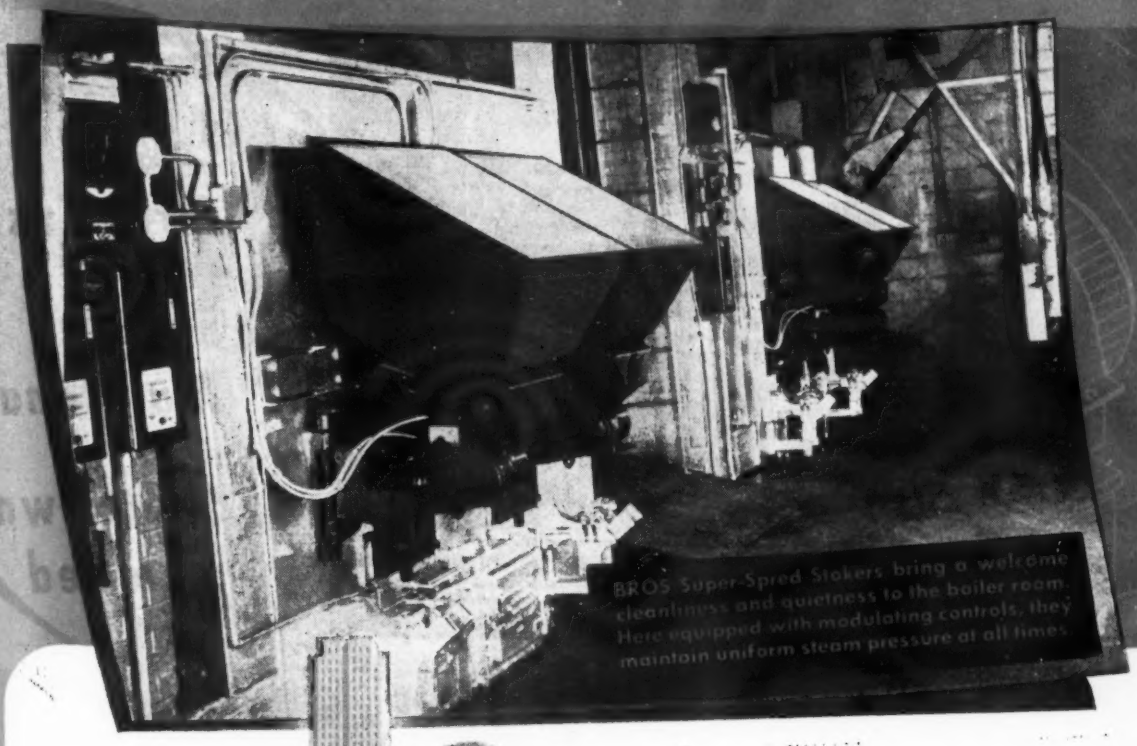
AGENTS IN PRINCIPAL CITIES

Badger PACKLESS CORRUGATED EXPANSION JOINTS

If it's Badger-made, it's got something!

25% Saving in Fuel

FOR NORTH DAKOTA'S CAPITOL



BROS Super-Spred Stokers bring a welcome cleanliness and quietness to the boiler room. Here equipped with modulating controls, they maintain uniform steam pressure at all times.

TWENTY-FIVE PER CENT FUEL SAVINGS—reports Mr. R. Rishworth, Secretary of the State Board of Administration, from the three heating seasons' performance with BROS Super-Spred Stokers installed in the State House in 1942.

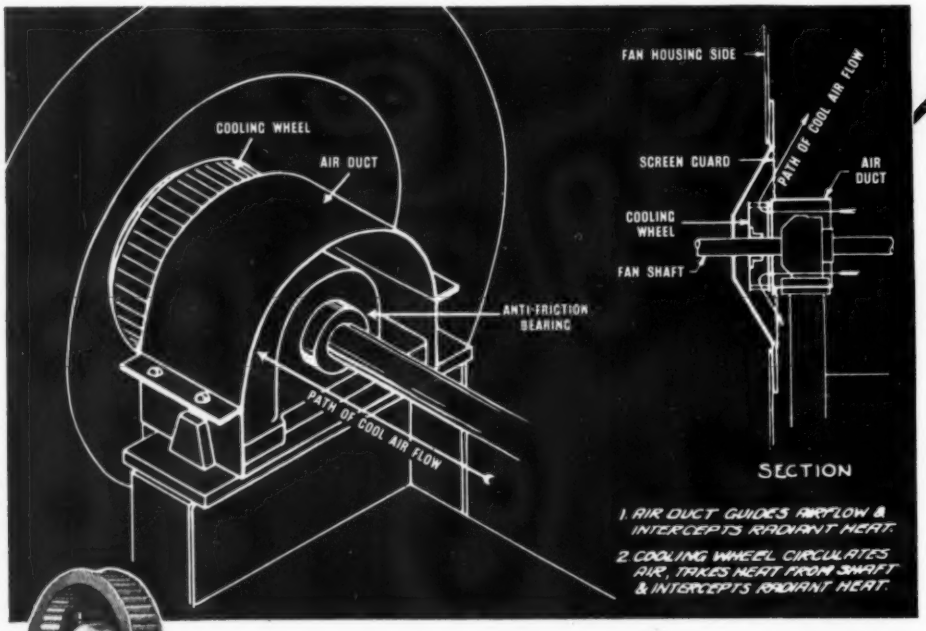
BEST BY TEST has placed many other Super-Spred Stokers in North Dakota institutions for they are not only designed to give economy, but also a continuous and uniform supply of heat regardless of the type fuel.

HERE AGAIN IS PROVEN TESTIMONY that you "get most from a Bros", a tradition that has been going on and on for more than 60 years of designing and manufacturing boilers, stokers, and other boiler room equipment. Bros resident representatives are ready to serve you with competent engineering counsel.

WM. BROS BOILER & MFG. CO.
Minneapolis 14, Minnesota

BROS *Steam Generating* EQUIPMENT

How to Simplify a Hot Fan Installation



1. Lower First Cost

2. Reduced Maintenance

3. Shutdowns Avoided

This small wheel located as shown above "does the trick"

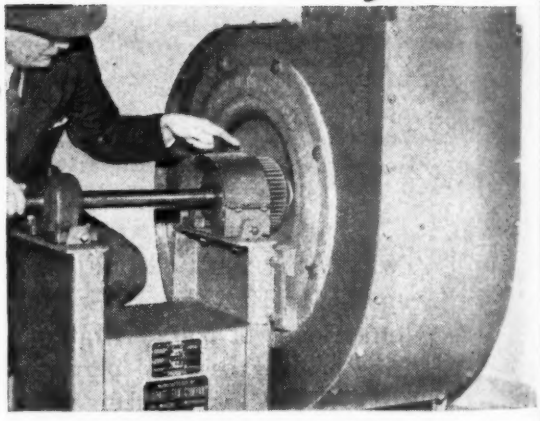
When you need fans for handling air or other gases at high temperatures, some provision MUST BE MADE for cooling the lubricant in the fan bearings. Usually, under these circumstances, the fan bearings are water-cooled.

But water-cooled bearings present all kinds of hazards! Leaks may develop, and water gets into the bearing oil — or someone forgets to turn on the water when the fan is started — or the water pipes plug up — or water in the pipes and bearing cases freezes, and breakage results.

That's why Clarage engineers developed the simple arrangement shown above. The small cooling wheel induces a continuous flow of cool air over the anti-friction bearings. It is effective and trouble-free.

No expensive water-cooled bearings or pipe lines required! You save handsomely in first cost and maintenance, and you eliminate entirely the chance of shutdowns due to someone's negligence.

O.K. UP TO 700° F. — *Clarage fans with air-cooled anti-friction bearings are recommended for jobs where temperatures range from 200° F. to 700° F. If you're interested in economy and more dependable operation, write us today.*



There's nothing experimental or untried about Clarage *air-cooled bearings*. We have been recommending them for years — hundreds of successful installations. Fan above is handling core oven gases in a large foundry.

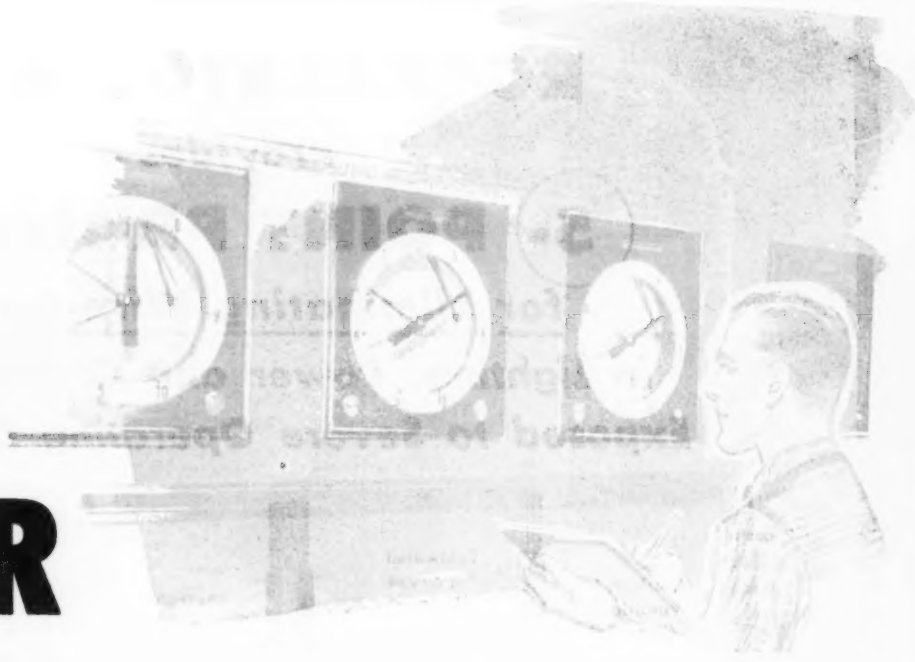
ARMY (E) NAVY

COMPLETE AIR CONDITIONING
COOLING • VENTILATION • MECHANICAL
DRAFT • HEATING • FANS FOR INDUSTRIAL NEEDS

CLARAGE
FAN COMPANY
Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

AIR POWER



for Automatic Control

Each day new applications of automatic control are solving new problems. These ingenious instruments reduce time, save man power, eliminate errors . . . make possible and practical many of our continuous processes.

The increasing use of *pneumatic* control is recognition of its many advantages . . . reliability, simplicity, safety and ease of maintenance. In many processes it offers the only practical solution of the control problem.

Such service demands the best of air compressors. When oil-free air is a "must" Ingersoll-Rand Type N-L (non-lubricated) compressors should be installed. In these compressors the cylinders are designed to operate without oil, glycerine, water or other form of lubricant . . . because they have special pistons fitted with graphitic carbon wearing rings and piston rings. Sizes from 5 to 300 hp . . . pressures up to 125 psi.

FOR COMPRESSORS FOR ANY SERVICE
CONSULT INGERSOLL-RAND

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COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS
OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

ROCKBESTOS A.V.C.

Provides a

5-POINT PROGRAM

for Eliminating Wire-Failures

in Lighting, Power and Control Circuits Exposed to Severe Operating Conditions

1. **National Electrical Code Type AVA** (max. operating temperature 230° F.) Rockbestos A.V.C. 600 Volt Boiler Room Wire in sizes No. 18 to 4/0 AWG. For lighting and control circuits around boilers, furnaces, steel mills, etc., and resistor wiring.
2. **National Electrical Code Type AVB** (max. operating temperature 194° F.) Rockbestos A.V.C. 600 Volt Switchboard Wire in sizes No. 18 to 4/0 AWG. For fireproof switchboard wiring. Takes right angle bends without cracking braid. Rockbestos A.V.C. Hinge Cable and Bus Cable also available.
3. **National Electrical Code Type AVA** (max. operating temperature 230° F.) Rockbestos A.V.C. 600 Volt Flexible Motor Lead Cable in sizes No. 18 AWG to 1,000,000 CM. For coil connections, motor and transformer leads exposed to heat and moisture, oil, grease and fire hazard.
4. **National Electrical Code Type AVA** (max. operating temperature 230° F.) Rockbestos A.V.C. 600 Volt Power Cable in sizes No. 18 AWG to 2,000,000 CM. For power circuits and hot-spot wiring in generating and industrial plants.
5. Rockbestos A.V.C. 600 Volt Multi-Conductor Control Cable in standard sizes, No. 12—19/#25 and No. 9—19/#22 (other strandings on order) with from two to nineteen conductors insulated the same as Rockbestos A.V.C. Power Cable except braids on individuals which are coded cotton.

Are repeated wire-failures tieing up equipment, slowing down production, and causing maintenance headaches? Then install Rockbestos A.V.C. heat and flame resistant wires and cables in the trouble spots.

These National Electrical Code type *permanently insulated* wires have the time-tested Rockbestos combination of lubricated varnished cambric and protecting impregnated felted asbestos insulation that stands up under high operating and ambient temperatures without baking brittle or flowing . . . without cracking open under vibration . . . without rotting or swelling when in contact with oil or grease . . . and without burning when exposed to flame. Rockbestos A.V. C. and other *permanently insulated* Rockbestos All-Asbestos (N.E. Code Types) wires, cables and cords are available in 125 different standard types . . . each designed specifically to give long life under severe service in lighting, control and power circuits . . . in boiler rooms, lehrs, steam tunnels, kilns, steel mill soaking pits and other hot-spot locations.

For complete information, samples and recommendations, write nearest branch office or:

Rockbestos Products Corporation, 991 Nicoll Street
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The Wire with Permanent Insulation

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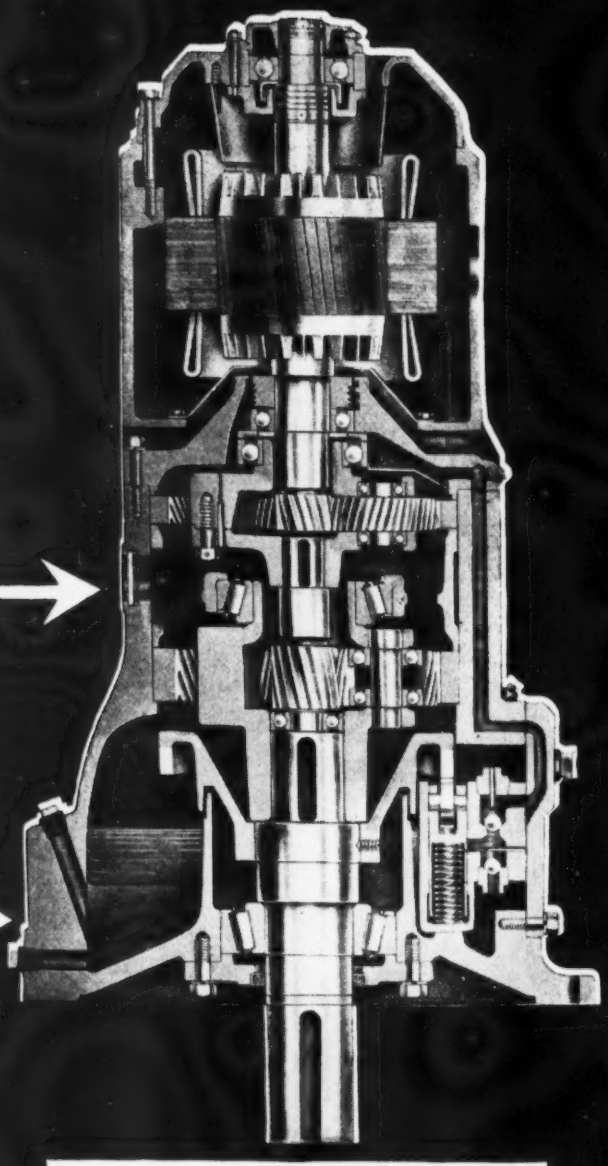
WIDE BEARING SPAN

. . . makes it ideal for overhead agitator drives, impellers, etc.



PHILADELPHIA
MOTOREDUCER

Because the slow speed shafts are mounted on generously spaced tapered roller bearings, the need for objectionable step bearings, in most cases, has been eliminated.

Another advantage of the MotoReduceR is the ring type base which simplifies mounting, when used on tanks or other machinery.

Furthermore, the units are absolutely leak proof . . . no stuffing boxes to leak or maintain. While all parts requiring it receive adequate lubrication, *no oil can leak out* . . . a most important feature for an agitator drive.

The vertical MotoReduceR can be supplied with output speeds from 12 to 450 R.P.M. in sizes from 1 to 75 H.P.

Our catalog MR 45 describing these self contained units as well as the horizontal type MotoReduceR will be sent on request. Please write on your business letterhead.

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Philadelphia GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK • PITTSBURGH • CHICAGO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

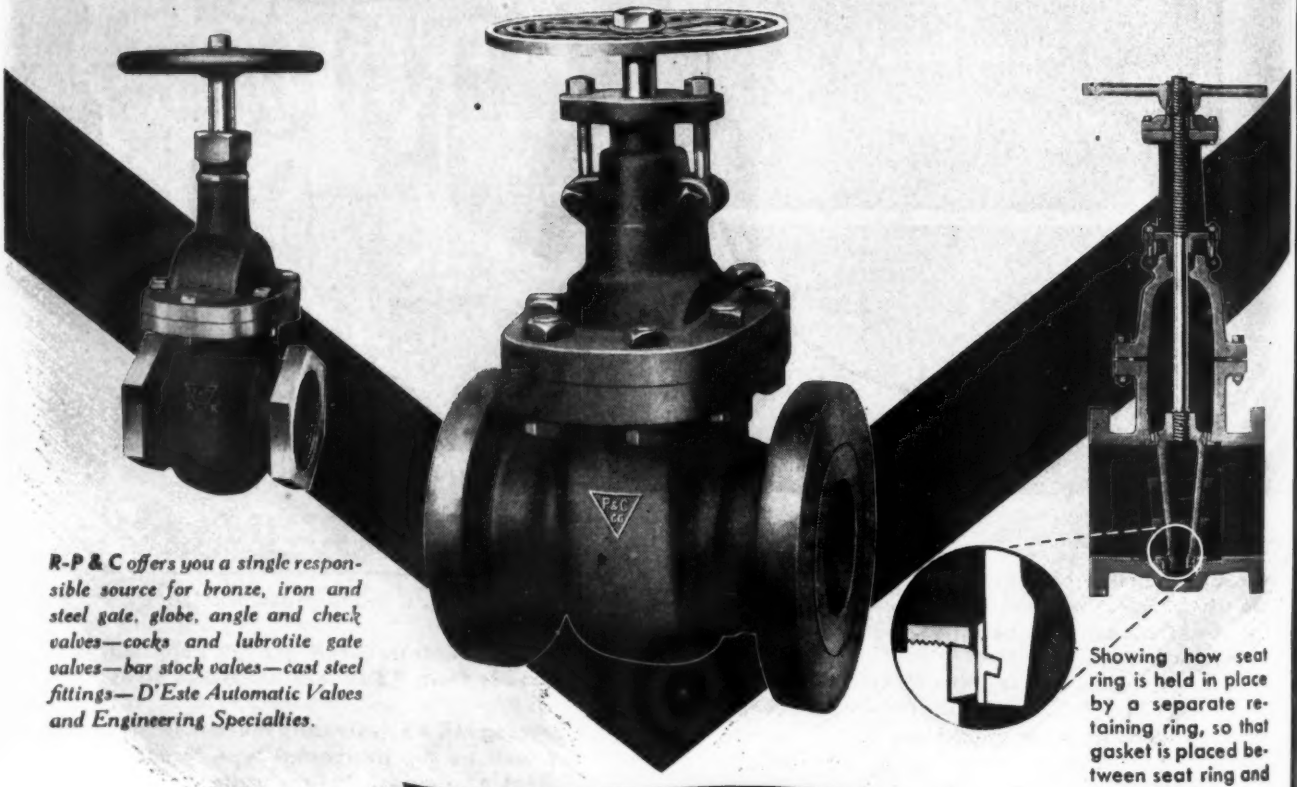
BETTER AND LONGER *Service* FROM *Gate* VALVES...

The retaining ring construction permits easy renewal of seats—with assurance of a good, tight job. This means a definite economy—especially in the larger size valves. But that is only part of the story.

The resilience afforded by the gasket between ring and body results in a more positive seal—better valve performance.

This retaining ring construction is exclusively a **READING-PRATT & CADY** development. It is typical of improvements in valve design constantly being made by **R-P&C** engineers, toward better valve performance and longer valve life.

Next time you have need for valves, get a recommendation from **READING-PRATT & CADY.**



***R-P & C** offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Valves and Engineering Specialties.*

Showing how seat ring is held in place by a separate retaining ring, so that gasket is placed between seat ring and valve body.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

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TRADE MARK

NO Seep! NO Leak!

...IN HANDLING

LIQUIDS & GASES

Including: *HIGHLY* CORROSIVE INFLAMMABLE & EROSIVE FLUIDS

Set it!—and forget it!

The New Grove Flexflo, fully self-contained Back-Pressure Regulator or Relief Valve provides positive *bubble-tight* shut off and insures absolute *leak-proof* control of even the most severe and hazardous types of liquids or gases. A pressure-actuated synthetic rubber tube contracts to close, *tight*—sealing off the flow ...and *instantly opens* with the slightest increase in line pressure. It is impossible to become corroded or stuck and automatically self-compensates for erosion or wear. With no packing glands or stuffing boxes, there is never any danger of seepage, leakage or failure. Once you set it—you simply forget it.

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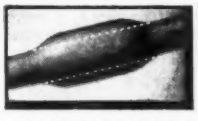
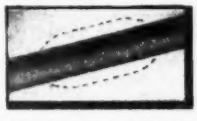


EXPANDS TO OPEN



CONTRACTS TO CLOSE

GROVE *Automatic... Self-Operating* FLEX-FLO

BACK PRESSURE REGULATOR—OR RELIEF VALVE

GROVE REGULATOR COMPANY

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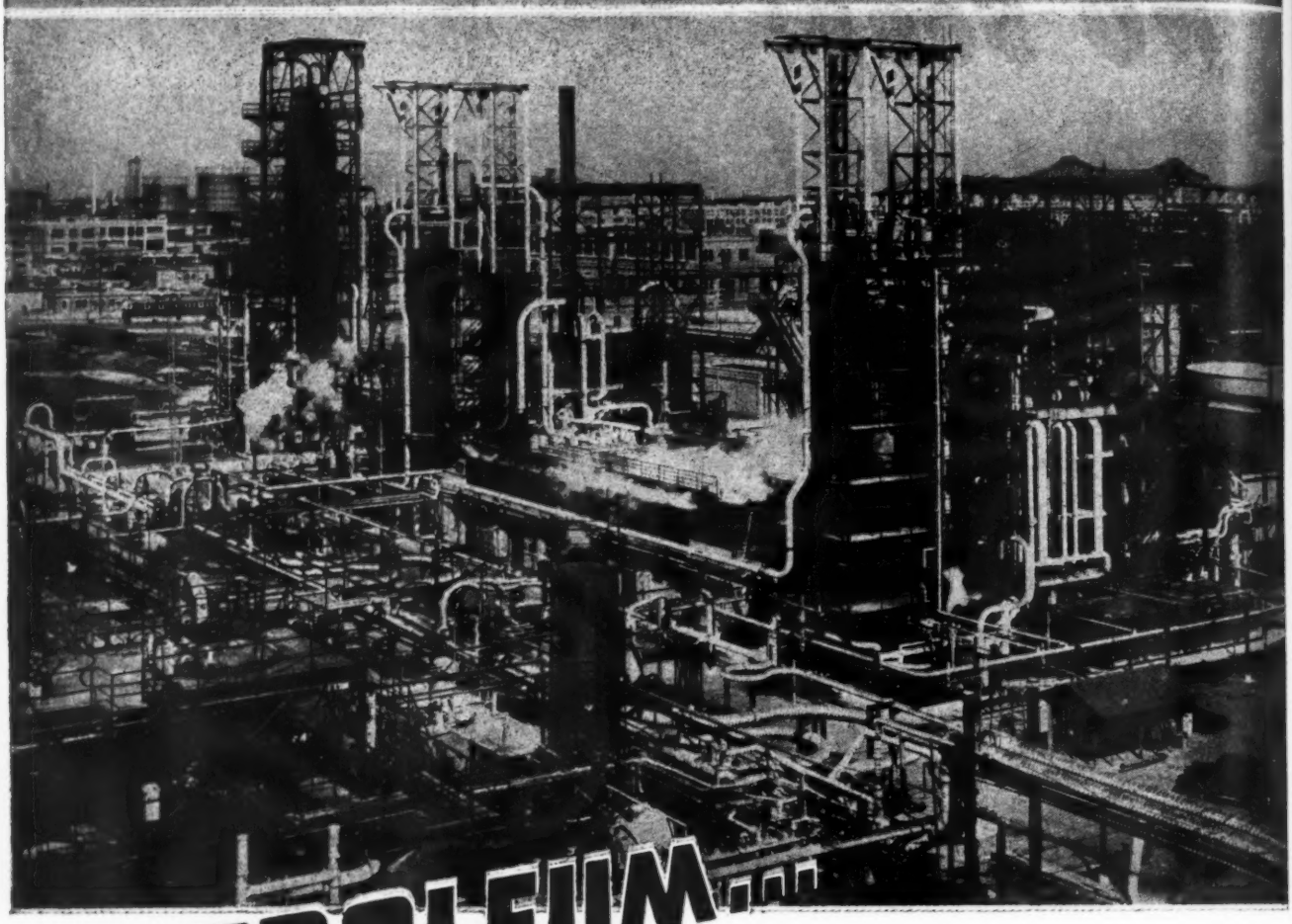
American industry flows through fairbanks valves

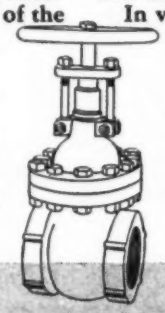


PETROLEUM... super-servant of industry

In fantastic mazes of piping and tanks . . . in silvery towers and glistening spheres . . . petroleum is broken down to serve industry with an almost unbelievable variety of products and ingredients. Its versatility appears limitless. What other man-perfected gift of nature, for example, can fuel a vehicle, lubricate it, and supply the synthetic for its smooth-running tires?

Operations must run smoothly in every phase of the oil processing industries in which petro-chemistry has scored so many technological advances. Close control of the flow of liquids and gases is all-important and accounts for the unusual care with which valves for such pipelines must be selected.

"American industry flows through Fairbanks valves", and wide refinery use affords a good illustration. One type serving the oil and gas fields is the iron body bronze-mounted gate valve below. Other Fairbanks valves recommended for use in the petroleum industries as well as on steam, gas, water and process liquid lines in all industries are all-iron gate valves as well as bronze valves in gate, globe, angle, and check types.



In valves as in all heavy-duty equipment, there's no substitute for substantially-built units made to close tolerances from metals that are rigidly controlled. There's no substitute for experience such as Fairbanks has gained over its fifty year span of service. For your reference files, write for a Fairbanks Catalog 42, which gives specifications and prices. With it, we'll send nearest distributor's name.

THE fairbanks COMPANY

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520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.

Slickest *"escape act"* on earth!

NATIONWIDE DISTRIBUTION—Warehouse stocks of the broad Carey Line provide service regardless of job location.

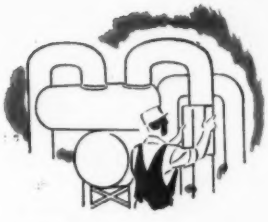
CAREY INSULATION ENGINEERING SERVICE makes available the knowledge and experience of leading authorities.

You can't beat a BTU for getting out of places. Bare piping, for example, is his dish. Proper insulation is his nemesis.

It isn't a question of needing industrial insulation. It's what kind will most effectively solve your particular heat loss problems.

Your surest solution lies in (1) a broad line of types, forms and shapes of insulation and (2) the engineering experience and resourcefulness to determine the one best insulation or combination for your job. Carey can deliver both—has been doing it for over 50 years.

For information on Carey Heat Insulations and Engineering Service write—



TRAINED ERECTION AND SERVICE CREWS "make sure" the job is done right.

BROAD LINE FROM ONE SOURCE. No need to compromise with desired results. You get the *right* insulation for the job.

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ask yourself THESE QUESTIONS

Before Selecting a Piping Contractor

"Has he had extensive experience on jobs like mine?"

MIDWEST organization has erected piping for more than four decades and in that time has handled every type of piping job. Whether you have a power plant . . . a chemical or process plant . . . or whatever your piping needs may be Midwest offers you a wealth of experience on comparable jobs.

"Does his fabricating plant have all the facilities needed?"

MIDWEST has four modern pipe fabricating plants. Each is equipped for any kind of piping job: layout tables . . . bending equipment . . . work rotating fixtures for welding . . . special lap-forging machines . . . etc. You will find no better equipped pipe fabricating plants.

"Is his location convenient?"

MIDWEST plants are strategically located to give quick service to any part of the country. Each plant is a complete unit but they work together on large jobs where time limitations do not permit all fabrication in one plant.

"Are his organization and erecting facilities adequate?"

MIDWEST places a resident engineer with a permanent staff of supervising erectors on the job. All Midwest qualification welders are from our own shop organizations. Midwest carefully controls the flow of materials from drawing board to the complete installation.

"Has he kept abreast of recent piping developments?"

MIDWEST has done more than that . . . among Midwest developments are the Globack joint which greatly improved lapped joints, the Midwest saddle for better reinforcing branch outlets, and a complete line of pipe welding fittings. Midwest piping research is continuous.

"Can he be of any special help on my job?"

MIDWEST gives you the benefit of a thoroughly experienced organization prepared to offer the advantages of any new piping developments. Our wide experience in all kinds of pipe work often enables us to make suggestions which result in better piping at lower cost.

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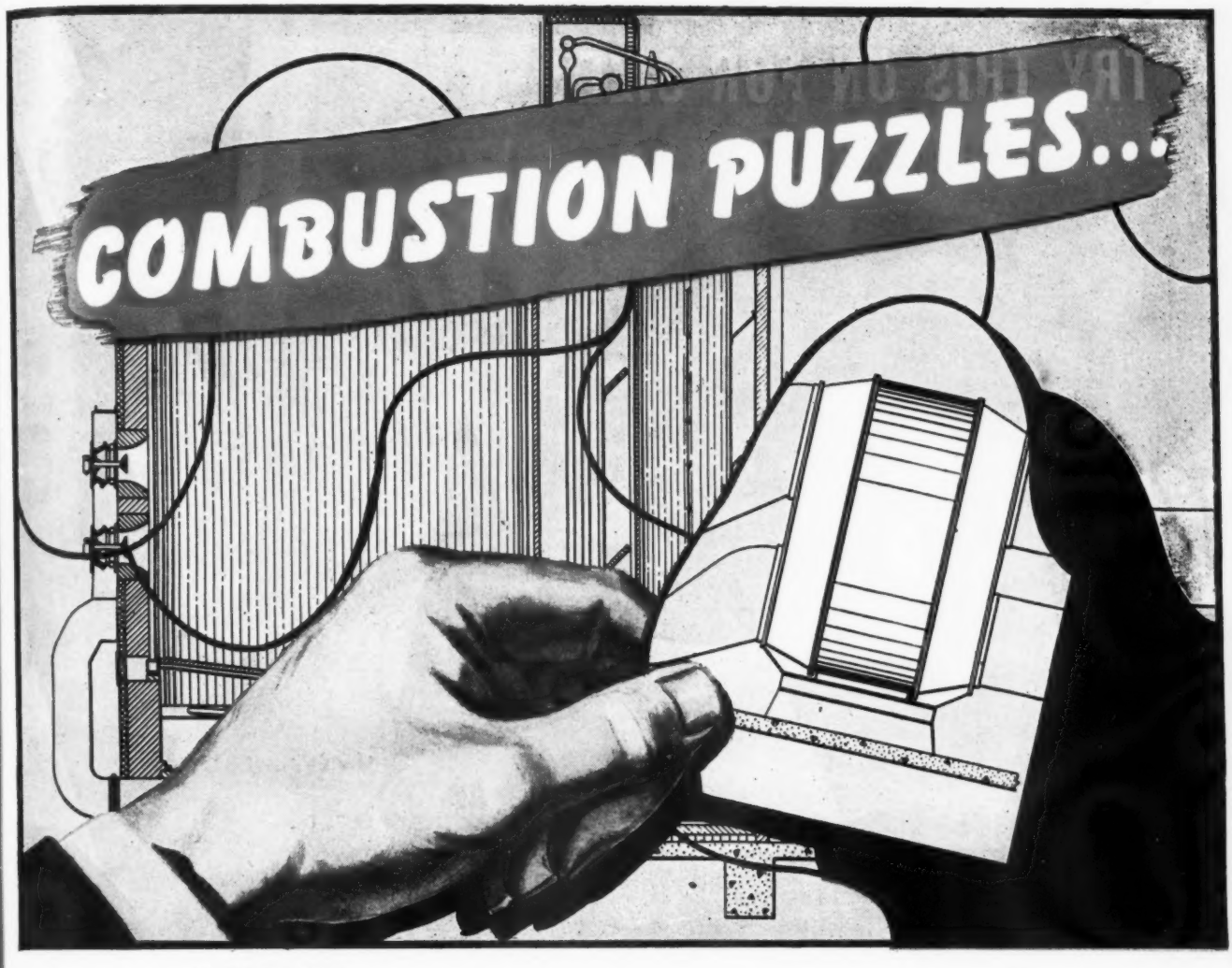
PIPING FABRICATORS AND CONTRACTORS



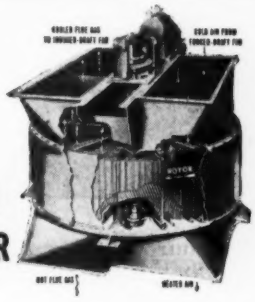
ARE HIS BUSINESS

Combustion puzzles presented by today's fuels are among the problems which *preheat engineering* may be able to solve for you.

Helping keep combustion efficiency high is the business of our "preheat engineers". So, if you are faced with a problem of bettering combustion through heat recovery, these engineers are at your service, regardless of whether or not you are now a user of the Ljungstrom Air Preheater.

If you plan to modernize your steam generating plant, or to build a new one, it's to your advantage to call in a preheat engineer while plans are still in the formative stage. And for many problems of gas-to-air or air-to-air heat exchange in process applications, our staff can offer new ideas.

THE LJUNGSTROM AIR PREHEATER



The continuous, regenerative, counterflow principle of the Ljungstrom Air Preheater provides maximum heat transfer with minimum weight and size. The rotating, cylindrical heat transfer surface, "soaks up" heat in the gas chamber, then rotates into the chamber where it gives up this heat to the entering air.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

TRY THIS ON FOR SIZE

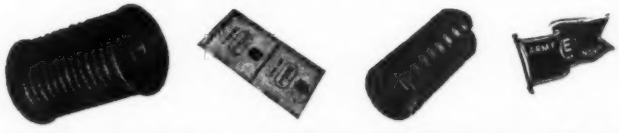
MAYBE your packing requirements are freaks. If so, R/M makes over 70 different types of packing, and each one in a wide variety of sizes for practically every type of equipment.

Spiral packing, rings, spools and coils are available from ⅛" diameter to 2½". They are also available in round, square, and oval cross-section. Also with or without wire reinforcing.

R/M packing is designed to end dripping and leaking in pumps, engines, valves, compressors, wherever fluids or gases are being handled.

Talk to your distributor about the R/M packing, made for your particular packing needs. Ask for a copy of the R/M packing book.

It's "Packed with Satisfaction"—When You Use R/M



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Eliminate DAMAGING WATER and OIL from Your Compressed Air Lines

WITH

ADAMS AFTERCOOLERS and CYCLONE SEPARATORS

Air Cooled to Within 10 DEGREES of Cooling Water! EASILY INSTALLED! Pipeline Construction

● ADAMS equipment insures a constant supply of cool, moisture-free, oil-free air to power your compressed air tools with the highest efficiency and safety . . . at the *lowest* installation and maintenance cost.

ADAMS AFTERCOOLERS are *guaranteed* to cool air to *within 10 degrees* of your cooling water. This means *extra* thoroughness in condensing water and oil vapors from your compressed air.

NO FOUNDATION or other facilities are required for installation. The Adams "pipeline" construction permits the After-cooler and Cyclone Separator to fit right into a section of the pipe line . . . either vertically or horizontally!

CYCLONIC SEPARATION is the Adams principle . . . engineers agree that it is *far more efficient* than other mechanical separation!

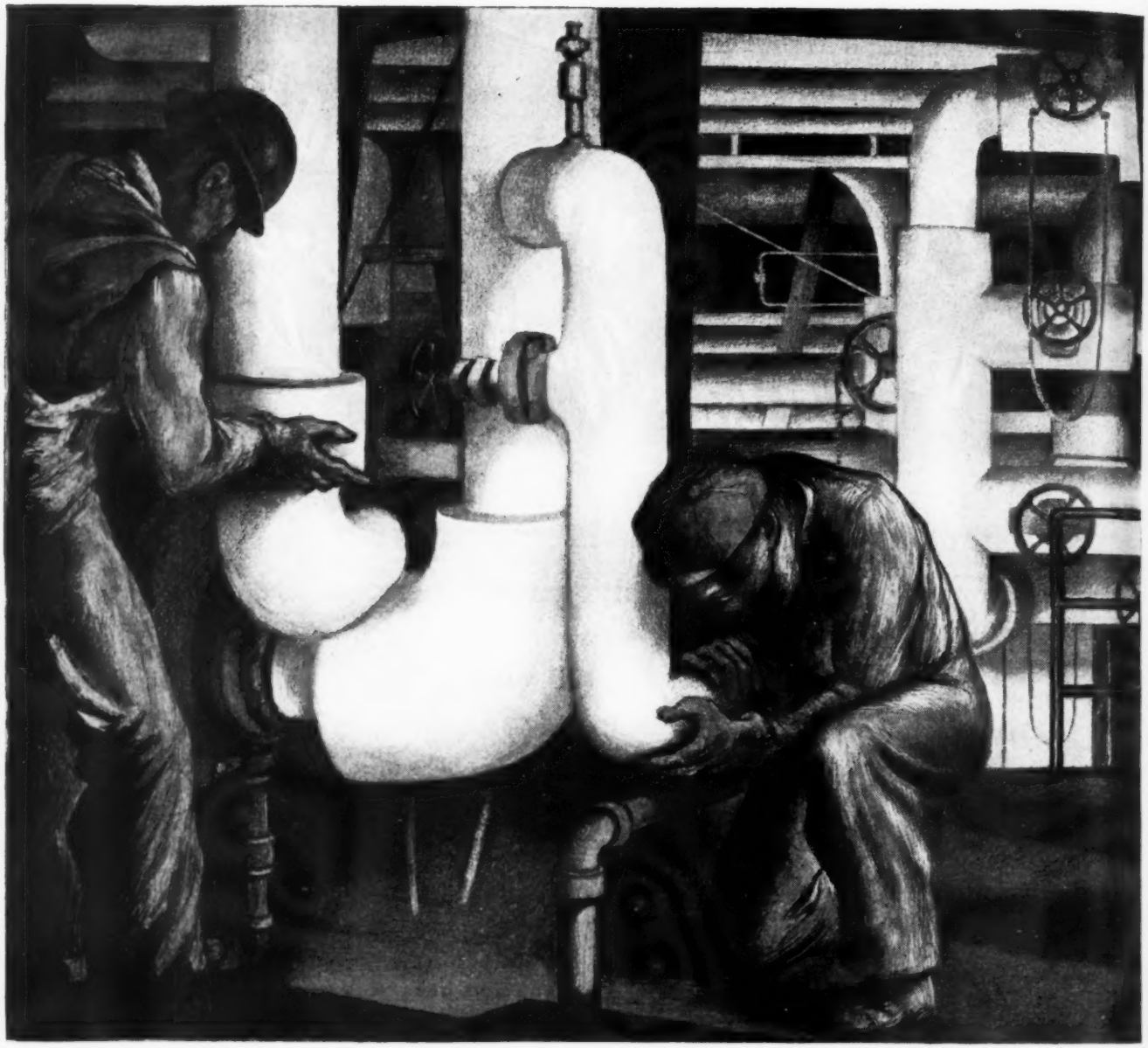
WRITE!

today for full engineering data on improved pneumatic power performance. Ask for Bulletin 703.

R. P. ADAMS CO., INC.

67 Chicago St., Buffalo, N. Y.

ADAMS AFTERCOOLERS and CYCLONE SEPARATORS



ORIGINAL LITHOGRAPH BY BENTON SPRUANCE

Fighting Btu's

THE Btu's produced in boilers and distributed through steam lines are not only fighting the wartime battle of production. They also fight, year in and year out, to escape in the form of heat losses. Industry's effort to prevent the waste of heat is never-ending.

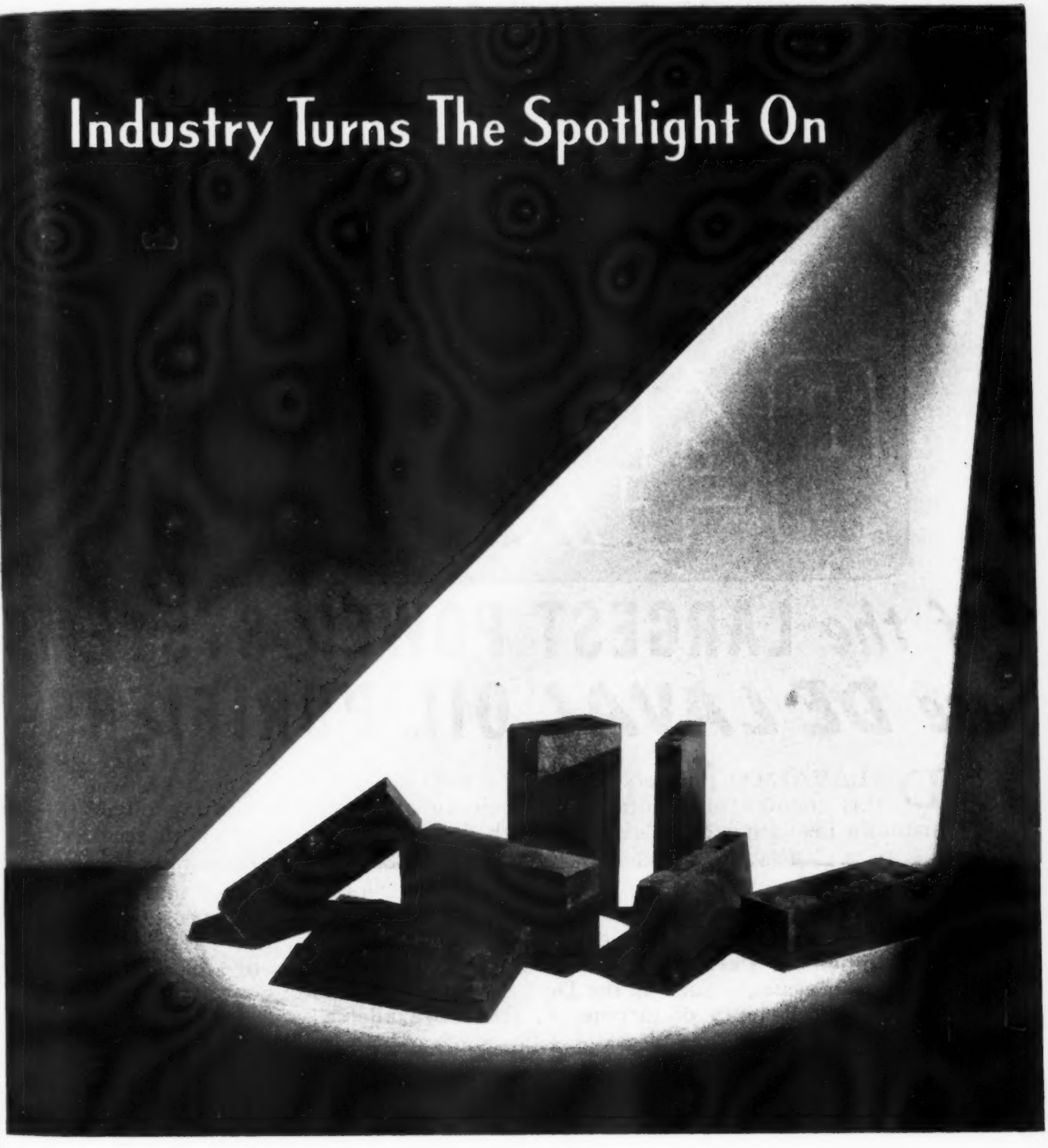
The battle against heat loss is as broad as all industry. With every boiler, steam line, fitting and heated surface a potential avenue of waste, they should be amply protected with a highly efficient thermal insulation such as Ehret's 85% Magnesia or Enduro. These time-defying insulating materials have been conserving heat in countless installations for nearly half a century. Those who specify or use these materials like them because they are dependable, economical and trouble-free.

THE EHRET HEAT INSULATION HANDBOOK *contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations — with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. A copy will be sent at your request.*

EHRET

MAGNESIA MANUFACTURING CO.

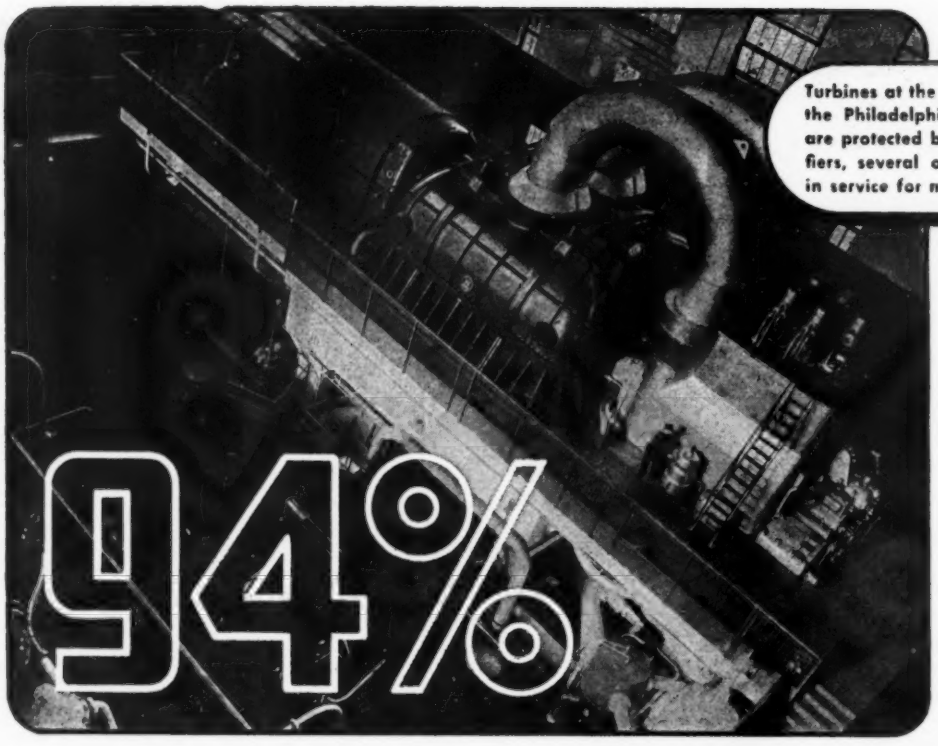
VALLEY FORGE • PENNSYLVANIA



CRYSTOLON BRICK

Wartime peak operation emphasizes CRYSTOLON Brick's outstanding quality — long, trouble-free service . . . . a serviceability derived from these characteristics: (1) great refractoriness, (2) chemical stability, (3) resistance to abrasion, (4) resistance to the corrosive action of ash and the penetration of slag.

NORTON COMPANY - - - Worcester 6, Mass.



Turbines at the Richmond Station of the Philadelphia Electric Company are protected by De Laval Oil Purifiers, several of which have been in service for many years.

of the LARGEST POWER SYSTEMS *use* DE LAVAL OIL PURIFIERS-

DE LAVAL Oil Purifiers are used by 94% of the largest power systems in this country to maintain the efficiency of turbine lubricating oil or to maintain insulating oil at required high dielectric value, or for both services.

De Laval Oil Purifiers are available as stationary, semi-portable, or fully portable units. "Uni-Matic" self-contained units include Purifier and pumps, heaters when desired, gauges, sampling cocks, etc. A blotter press may be included as an auxiliary for the removal of colloidal carbon from circuit breaker oil. Individual Purifiers are also obtainable in a wide range of capacities. Processing systems, such as the De Laval-Funk method of continuously maintaining the efficiency of turbine oil, are also available.

De Laval Oil Purifiers are *more* efficient, *more* economical, and are supplied in types *more* nearly suited to the needs of the individual plant or system. Hence, they are preferred by *more* companies having need for oil purification equipment. Write for additional details.

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THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

The Proper Equipment . . . CORRECTLY APPLIED

An example of a Johnson *Summer-Winter* Thermostat and Humidostat for year-'round Individual Room Control.

On the Job—to *Do* the Job

Look at the heating and air conditioning system in any building—residential, commercial, public, institutional, industrial. Each installation presents an individual problem, calling for the best specialized knowledge. Manufacturing fine automatic temperature control equipment is not enough—*correct application* is also necessary. That is why there are Johnson engineers in every large city.

Johnson men . . . everywhere . . . cooperate with architects, consulting engineers, contractors, and owners. Years of training and experience enable them to bring expert knowledge to bear on the proper application of every element in the complete control system.

Their obligation does not end with manufacturing and selling the *best* in automatic temperature control equipment. That is why they are called upon, time and again, to aid in solving temperature control problems for the same people. On *your* next temperature control problem, ask your heating and air conditioning engineer or contractor about Johnson . . . or call a Johnson engineer from a nearby branch.

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MANUFACTURE
INSTALLATION
SERVICE

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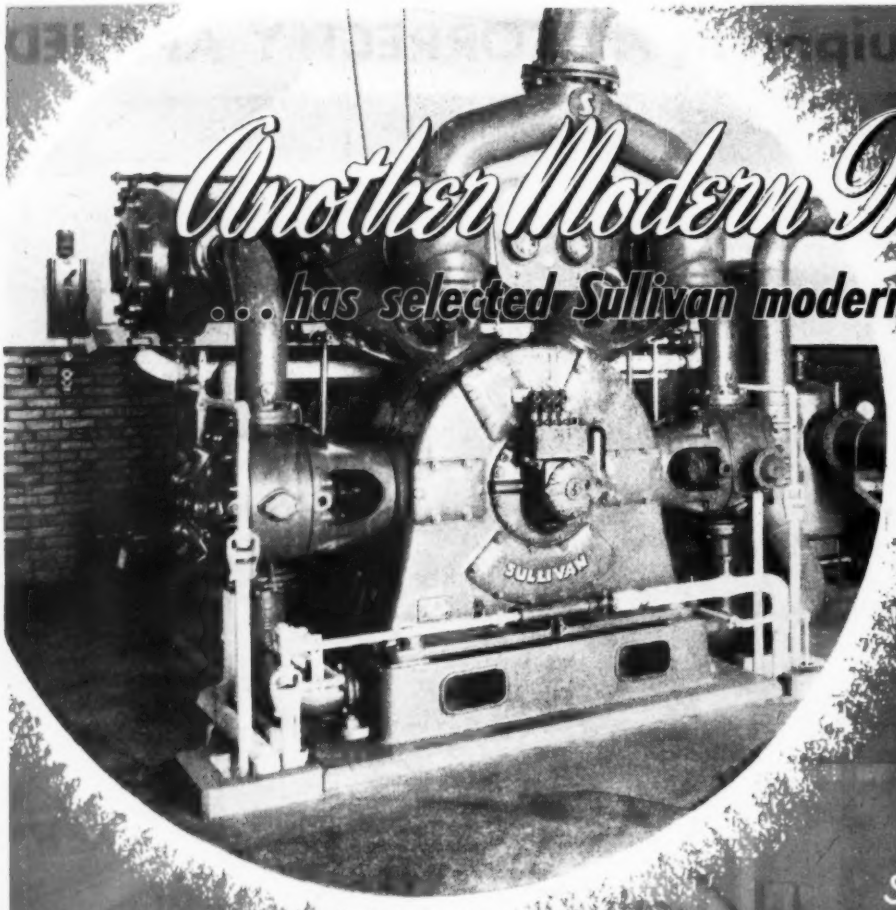
SERVICE COMPANY
MILWAUKEE 2, WISCONSIN
AUTOMATIC TEMPERATURE AND AIR CONDITIONING CONTROL

Another Modern Industry

. . . has selected Sullivan modern air power . . . .



LIKE so many other industries that have progressed by the bold and continued adoption of better and better methods, materials and machines, aviation has achieved the impossible in production of military planes. The contribution of compressed air from Sullivan *modern* air compressors cannot be emphasized too highly.

This SULLIVAN WN-114, four cylinder semi-radial air compressor recently installed in the newest plant of the largest aviation company, drives hoists, chucks, and boring mills, cleaning, sandblasting and other air equipment and is used at reduced pressures in the all-important air-flow combustion control systems of the power plant itself. Many other aviation companies have similar installations working continuously.

Sullivan Series 100 Air Compressors are two-stage, double-acting, long-lived, heavy duty continuous service compressors—much more compact than old style compressors of the same capacity and yet have operating economies exceeding older and bulkier units. They are available in two and four cylinder models and in single or twin units with capacities from 378 C.F.M. to 3656 C.F.M.

Sullivan Machinery Company, Michigan City, Ind. In Canada: Canadian Sullivan Machinery Co., Ltd., Dundas, Ontario

SPERRY

Thompson Products, Inc.

SOLAR AIRCRAFT COMPANY

BENDIX AVIATION

STUDEBAKER

BELL Aircraft

Airacobras for victory—

SULLIVAN

AIR COMPRESSORS FROM 1/4 TO 3,000 H.P.

PRODUCTS

Stationary and portable air compressors from ¼ to 3,000 H.P., pneumatic casting grips, foundation breakers, portable hoists, rock drills.

OFFICES { Seattle, Portland, San Francisco, Los Angeles, Salt Lake City; Boston, Pittsburgh, Birmingham, Duluth, Scranton; New York, St. Louis, Knoxville, El Paso, Denver; Chicago, Detroit, Huntington, Butte, Dallas }

Your Name* Here...

may save you money and invaluable time

When industrial furnace enclosure repairs become necessary today, there's a lot of satisfaction in knowing that they can be made efficiently — and quickly — under the supervision of the company which designed those enclosures.

If you are fortunate enough to have Bigelow-Liptak furnace enclosures in your plant—the entire record of the installation; its description and lists of all repair parts are at the finger tips of our production department—ready to be used at a moment's call to help you get your furnace back in efficient operation in a minimum of time.

Experiences like the recent predicament of one of the major oil refineries prove the value of this Bigelow-Liptak feature. By means of comprehensive Trade Cards — that cover every Bigelow-Liptak installation from one end of the world to the other—recommendations were made over the telephone to this refinery which was having difficulties because war production during the last several years had forced operation to almost double its designed capacity. Necessary repair parts were indicated. A fully informed engineer was rushed to the job. And this aviation gasoline plant which had operated five years without repairs was back in service in four days at this greatly increased rating.

"Please accept our appreciation for the effort made to put this plant back in operation. It is nice to know we are dealing with companies and individuals who feel an interest and a responsibility in the jobs they have furnished," wrote the chief engineer of this great refinery. This is but one of dozens of recent tributes paid to the cooperation, engineering skill and efficient organization of Bigelow-Liptak.

Your operation may depend not only on the design of the heat enclosure but the cooperation and efficient organization that backs it up.

It will pay you to discuss your heat enclosure problem with Bigelow-Liptak — if you want enclosures that will give service and economy over a long continuous operating period. Get in touch with a Bigelow-Liptak engineer.

***In the general office of Bigelow-Liptak** there is a Trade Card that contains a detailed record of every installation. On this card will be found all of the data and information necessary and useful in servicing the job. Many of these cards are never referred to because Bigelow-Liptak enclosures are designed for long dependable service. But since furnace enclosures are the parts most subject to wear and tear, these records often become life savers for our customers.*

When emergencies come we can quickly refer to any customer's Trade Card and find an accurate record of any installation. In a few minutes, with the aid of this information, we can set in motion the work that will enable him to get his furnace back in service in a minimum of time. Your name on a Bigelow-Liptak Trade Card may save you money and invaluable time.

BIGELOW-LIPTAK

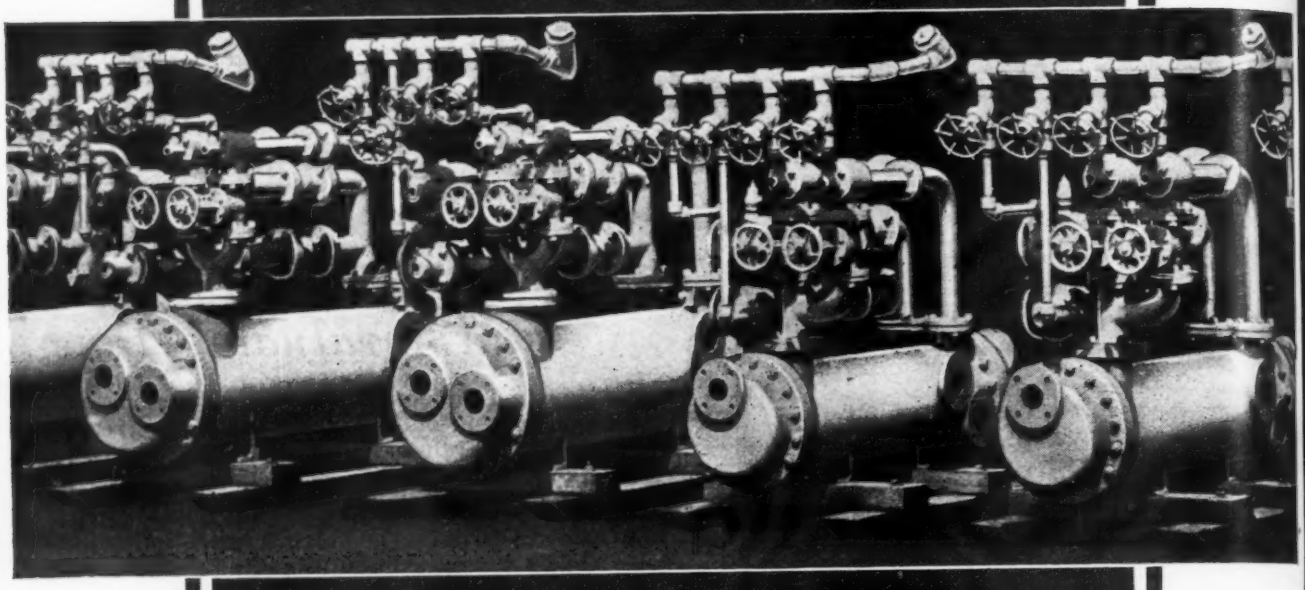
Unit-Suspended Walls & Arches

BIGELOW-LIPTAK CORPORATION
DIVISION A. P. GREEN FIREBRICK CO.

BIGELOW LIPTAK Corporation

330 CURTIS BUILDING — DETROIT 2, MICHIGAN

A Unit-Suspended Wall & Arch for Every Furnace



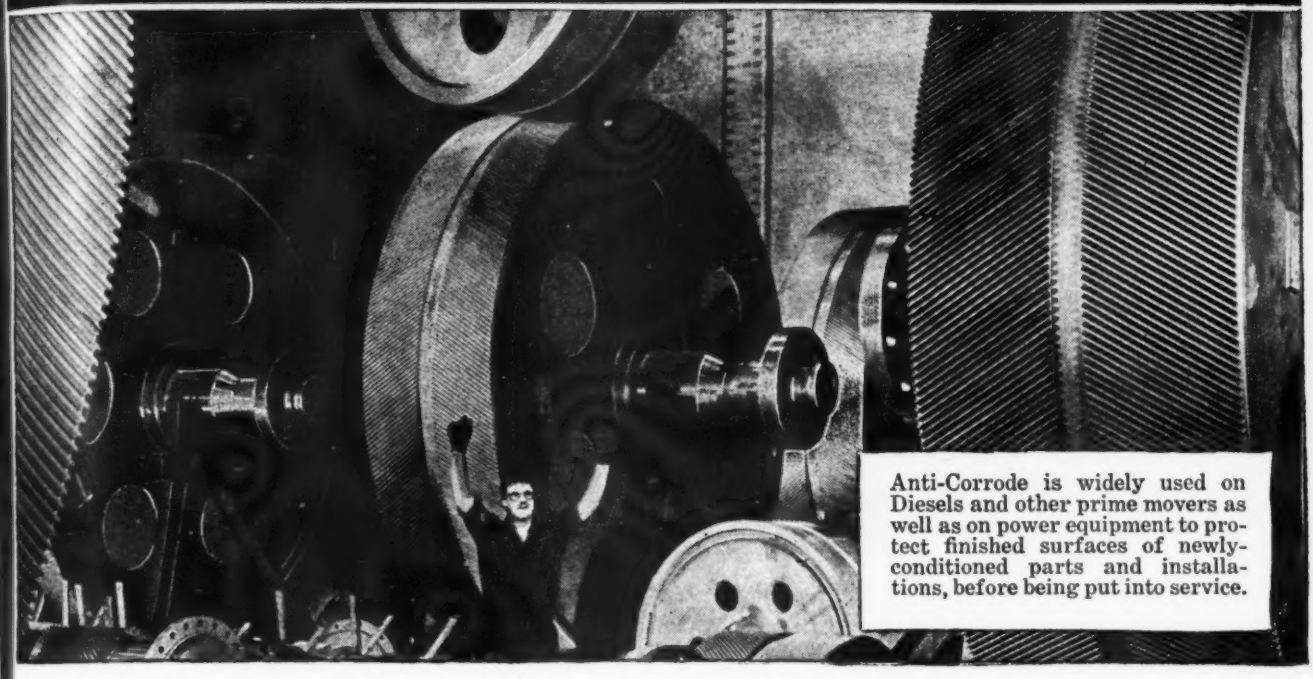
If you are going to buy a steam jet ejector now or in the future, select this improved type built with plenty of "knowhow" - - - - -

AWARDED THE MARITIME "M" PENNANT AND VICTORY FLEET FLAG APRIL 8, 1944

GRAHAM MANUFACTURING CO., INC.

415 LEXINGTON AVENUE • NEW YORK 17, N. Y.

STOP RUST *this New, Efficient Way—*



Anti-Corrode is widely used on Diesels and other prime movers as well as on power equipment to protect finished surfaces of newly-conditioned parts and installations, before being put into service.

Anti-Corrode film protects your metal parts and equipment ... prevents corrosion and rust formations

Anti-Corrode #100 is one of several new types of Cities Service protective coatings for metals. Designed to prevent corrosion of raw stocks, finished parts and completed machines—either in storage or in active service—Anti-Corrode adheres firmly to metal surfaces, displaces moisture and protects longer than similar materials now on the market.

Cities Service Anti-Corrode #100 may be applied by ordinary work-shop methods—spraying, dipping, brushing or rolling. Independent of metal quality, finish and irregularity of surface, the protective film is continuous and non-porous—does not break at sharp edges nor rupture on flat surfaces.

Cities Service Anti-Corrode #100 serves as a lubricant as well as a rust preventive and need not be removed from metal to be stamped, drawn, or otherwise formed. It can be removed simply with kerosene or any petroleum solvent.

ANTI-CORRODE Gives You 10 BIG ADVANTAGES

1. Adheres to all metal surfaces.
2. Impervious to humid atmospheres.
3. Water-repellent.
4. Resistant to sun rays.
5. Chemically inert to ferrous and non-ferrous metals.
6. Inhibits *"under"* rusting.
7. Easy to apply—easy to remove.
8. Lubricates as it conserves.
9. Will not become brittle.
10. Protects metals in service or storage.

There is a type of Cities Service Anti-Corrode for every need ... for a single valuable tool or a million dollars worth of metal or equipment. Mail this coupon for a free demonstration.

CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY

ARKANSAS FUEL OIL COMPANY

ANTI-CORRODE

SAFEGUARD FOR THE DIESEL AND POWER INDUSTRIES

Cities Service Oil Company
Room 296
60 Wall Tower, New York 5, N. Y.

Gentlemen: Please contact me for a FREE demonstration of Anti-Corrode in our plant. (This offer limited to industrial users in Cities Service marketing areas East of the Rockies.)

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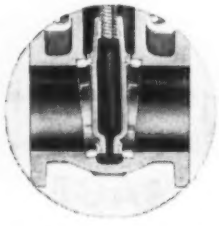
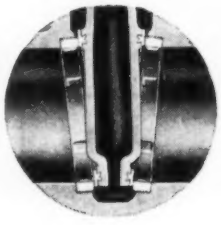
WALWORTH PRESENTS *A New Line of* IRON BODY GATE VALVES

with screwed or flanged ends

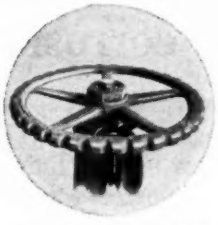
... *8 Outstanding Features*



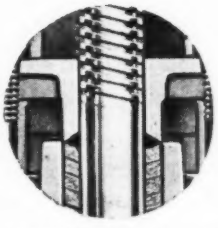
Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



Seat Rings of end-seated type are screwed into the body.

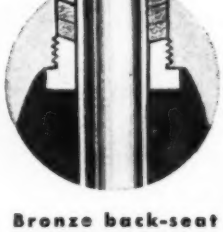


Cure-Grip Malleable handwheel for non-skid gripping even with heavy gloves.

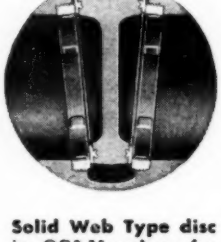


Brass Liner on Glands assures greater resistance to corrosion and scoring.

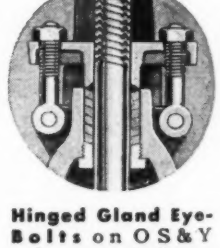
T-head disc-to-stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.



Bronze back-seat bushings in bonnets of OS&Y valves. (As soon as W.P.B. Limitation order permits.)



Solid Web Type disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

12 AWARDS TO 4 PLANTS

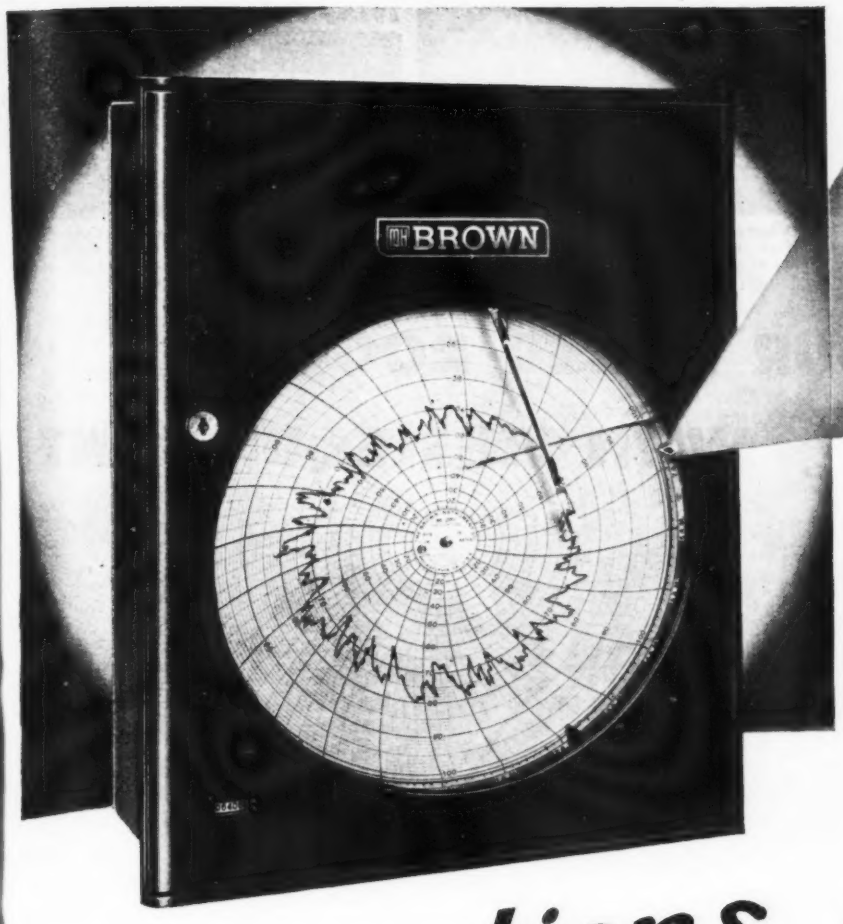
WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

For Complete Information on these new Walworth Iron Body Valves, write for bulletin 106.



Simplifies Cost Accounting

AUTOMATIC PLANIMETER PEN RECORD shows steam flow in volume units and the time at which it was produced or used in any part of the 24 hour period, enabling you to analyze the cost of steam production and distribution.

3 Questions and 3 Answers

If you use steam for power, process or heating—

Q:—*Do you know how much steam is generated for each dollar expended for fuel?*

A:—Brown Dual Chart Records show the rate and total amount of steam produced or purchased.

Q:—*Are your Boilers operating at their highest efficiency?*

A:—Brown Electric Flow Meters enable operators to maintain maximum boiler efficiency—thus effecting savings in fuel.

Q:—*How economically is steam being used?*

A:—Brown chart records reveal instantly any deviation from the most efficient use of steam—enabling you to distribute departmental or process steam loads more uniformly over the working day.

Whether you buy steam or generate it within your own plant—every pound of steam saved—conserves fuel—and is a 100 cents dollar saving.

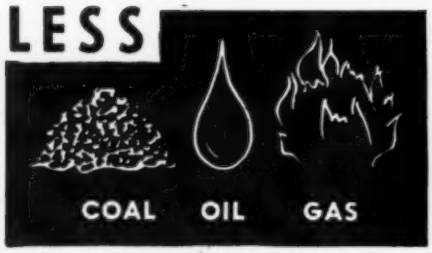
With Brown Electric Flow Meters you can correctly determine and properly allocate steam costs for power, process or heating. What Brown Indicating and Recording Electric Flow Meters are doing for others they can do for you.

Write for Catalog No. 2008. THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Co., 4490 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: London, England: Stockholm, Sweden.

Brown Electric Flow Meters

on the Inductance Bridge Principle

When you automatically maintain a constant draft in the combustion chamber, meter the air needed for combustion and regulate fuel feed, you get more steam from your present boiler.

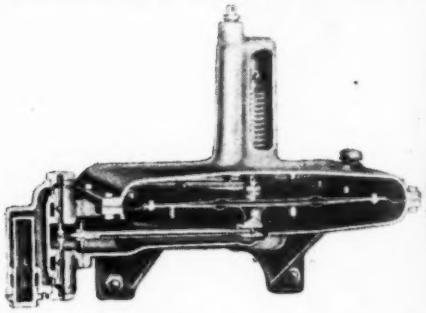


With automatic control you adjust the rate of fuel feed exactly to the load requirements at all times — no over-firing or under-firing — no waste in fuel.

Flue Damper is changed in accordance with furnace conditions to prevent combustion losses due to excess air. No fuel waste at any time.

OPERATE YOUR BOILER ROOM *for less* WITH THIS EQUIPMENT

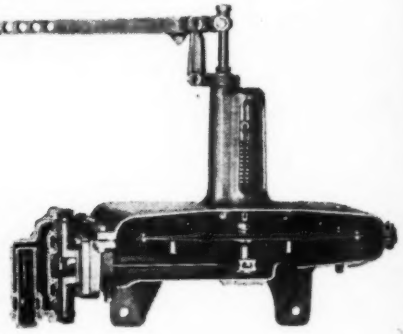
CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS



FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

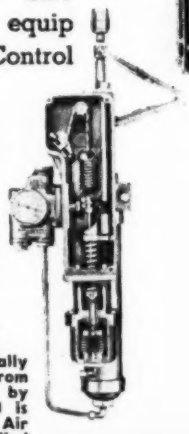
GET this continuous, automatic control in your boiler room and get the savings that come in smaller fuel bills, increased operating efficiency, and reduced maintenance. The units shown here are available in a number of variations — combinations of these units can be made to give you complete automatic control with all of its benefits, whether you have a stoker, pulverizer, oil-burning or gas-firing equipment on your boilers. Size of your boiler or type makes no difference — equip with CASH STANDARD Automatic Combustion Control and you increase its capacity.



GET A QUICK PICTURE OF THE ACCURACY, SIMPLICITY, ECONOMY, AND DEPENDABILITY

Send for Bulletin No. 300

Read the details of how CASH STANDARD Automatic Combustion Control works in your favor. This bulletin fully explains the performance of each unit and shows applications to different types of boilers.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

TERRY

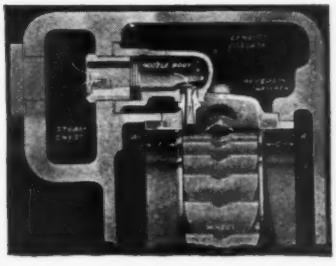
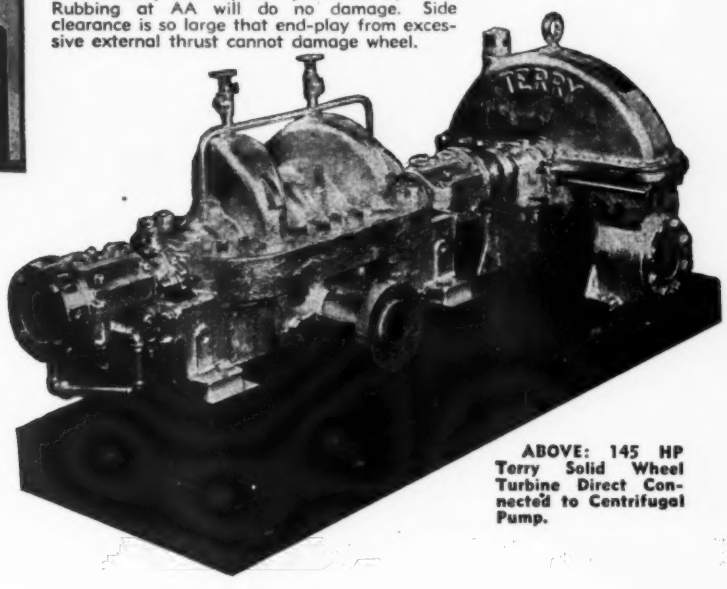
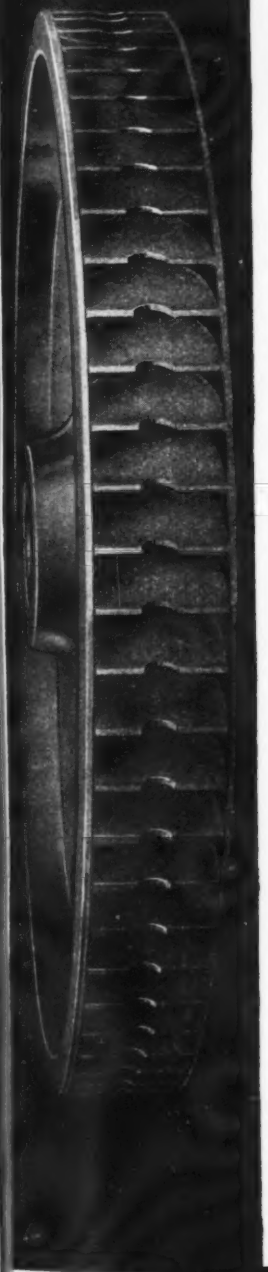


DIAGRAM SHOWING WHEEL CLEARANCES.

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



ABOVE: 145 HP Terry Solid Wheel Turbine Direct Connected to Centrifugal Pump.



THESE LARGE WHEEL CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

T-1158

THE TERRY STEAM TURBINE COMPANY

TERRY SQUARE, HARTFORD, CONN.

STATOR

Coils are form wound, diamond shaped interchangeable and carefully insulated with selected materials. Core is built of accurately punched mill varnished, motor special, electrical sheet steel.

ROTOR

Rotor is of all welded construction. The core is built of electrical sheet steel punchings having partially closed slots. The winding is made from hard drawn copper strip driven into the slots. The ends of the rotor bars are welded to copper or alloy end rings. These rotor bars also provide fan action for efficient ventilation.

LIFTING LOOP

All sizes have large lifting loop to accommodate crane hook for easy handling.

BRACKET & BEARING

Bracket is cast iron, simple design, providing rugged bearing support with ample lubrication and a minimum of parts and machined fits.

VENTILATION

Cooling air, circulated by rotor bar fan is taken in through bracket openings and discharged at the center frame opening.

FRAME

Constructed of rolled steel rings with heavy cross ribs, angle type web feet and electrically welded.

SHAFTS

Shafts are large and well proportioned of 30-40 carbon steel.

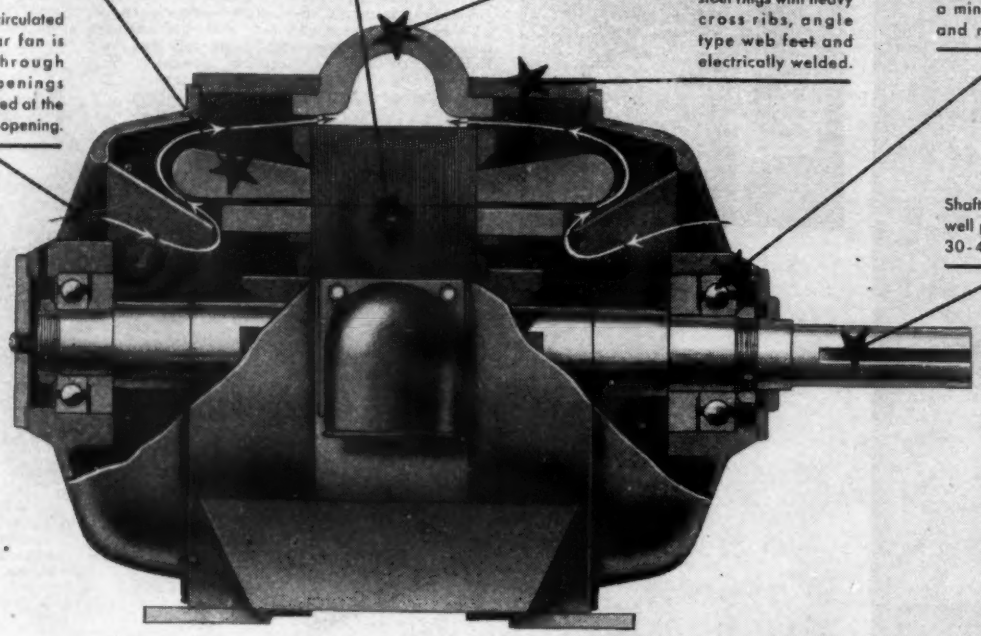
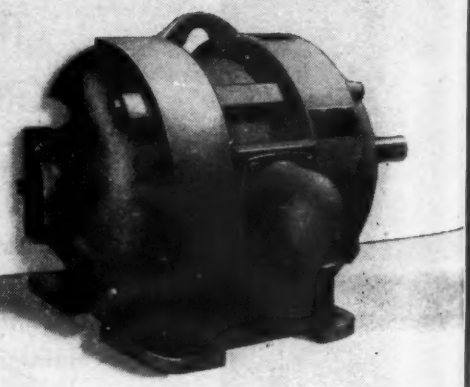


Illustration shows cross section view of Burke Type N 50 h. p. Induction Motor

BURKE *Induction* MOTORS *1 to 1500 h. p.*



BURKE is a quality motor builder producing a standard line of motors but also able to meet exacting specifications of special applications. Burke Induction Motors are built in sizes from 1 to 1500 h. p. in all types, open and enclosed, both squirrel cage and wound rotor. Let Burke build for you. Send your specifications to Burke engineers today. Write for Bulletin 101 describing Burke Induction Motors.

SYNCHRONOUS MOTORS AND GENERATORS | **INDUCTION MOTORS** | **D. C. MOTORS** | **D. C. GENERATORS** | **M. G. SETS** | **HIGH SPEED A. C. GENERATORS**

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

May we interrupt..?

We can assist you with your post-war plans

If you are thinking of the multi-story building you will build when the war is over — or

If you are among the thousands of progressive property owners and building managers who are thinking of modernizing their vertical transportation system when labor and materials are available —

We suggest that you get the planning behind you now as we have learned by experience that the preliminary plans for an elevator or escalator installation often take more time than is required for the manufacture and installation.

Your Otis representative is ready now to help you develop your elevator plans . . . to make preliminary studies and recommendations. Call him today and be assured of the last word in vertical transportation tomorrow.

Otis
ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

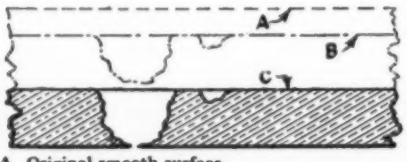
Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

What Gauge Condenser Tubing Should Be Used?

When considering the proper wall thickness of heat exchanger or condenser tubing many factors must enter into the decision. Since each of these has some bearing on the others, all must be carefully weighed before any selection is made. Five of the most important will be discussed.

(1) Corrosion

Severity and rate of corrosion taking place in a given installation will, of course, have important bearing on any decision regarding the wall thickness of tubing. For example, let us take a surface condenser with tube walls of .032" (21 gauge) and a good grade of steam on the outside of the tubes. Assuming that the circulating water attacks the metal at a rate of .002 ipy (inches per year) with a maximum pit depth of .016", the tubing should have a life of approximately 8 years (.002x8+ .016 = tube thickness of .032). Under the same conditions, tubing with a wall thickness of .049" (18 gauge) the life expectancy should be approximately 18 years. In other words, the additional .017 inch of metal more than doubles the life of the tubing in this particular case. This partially explains why .049" tubing is more universally used than are the lighter gauges.



A. Original smooth surface.
B. After some time, thickness of tube wall is reduced by corrosion, and pit has formed.
C. After still longer exposure, tube wall further reduced by more corrosion. Pit depth remains approximately the same, but now perforates the wall forming a pin hole.

It must be noted that the average rate of corrosion and maximum depth of pitting varies with service conditions and character of the tube alloy. Better corrosion resistance of an alloy may more than make up for additional wall thickness, and merits the most careful study.

(2) Mechanical Characteristics

For ease of installation, straight lengths of condenser and heat exchanger tubing must have the proper amount of rigidity, which in turn depends upon the wall thickness and temper, (hardness). Tubing which readily bends, sags, or dents will not permit the smooth, uninterrupted flow of liquid which is necessary for maximum efficiency. Flaring operations or rolling the tubes into the sheet are factors which also must be considered. If the walls are of too light a gauge or the metal has the wrong temper, it will be impossible to make a tight, dependable joint with the tube sheet. In bending operations, wall thickness and temper of tubing are also important. In the construction of heat exchangers, for example, tubing must frequently be bent into hairpin turns and spiral shapes. Even though the metal has good ductility, walls which are too thin may result in the tube wrinkling or flattening.

(3) Heat Transfer

In most installations, thickness of the tube wall is not particularly significant from the standpoint of overall heat transfer (usually called the U value), because films, scales, or deposits on both sides of the tubing greatly affect its heat transfer properties. Surface film generally retards heat transfer much more than does the metal itself. For example, clean Admiralty metal has a thermal conductivity of 760 B.T.U./ hr./sq. ft./ °F./in. On the same basis, water has a value of only 4.2, and air a value of only 0.15. It is evident from these figures that a thin film of water or air on a tube surface acts as an insulator and, therefore, has a profound influence on the overall heat transfer characteristics of the tubing.

Proper gauge means longer tube life and increased efficiency.

(4) Working Pressure

This has a very definite bearing on the gauge selected because higher working pressures require greater wall thicknesses. This is not important in surface condensers which operate at comparatively low pressures. However, certain types of heat exchangers operating at hundreds of pounds pressure, require tubes designed for such conditions. Also, allowance for corrosion attack must of course be made in figuring proper gauge because the factor of safety diminishes as the tube is thinned and weakened by corrosion.

(5) Economics

In addition to the initial cost of tubing, factors such as capital investment, cost of maintenance and repairs, cost of interrupted service, all are a part of the picture.

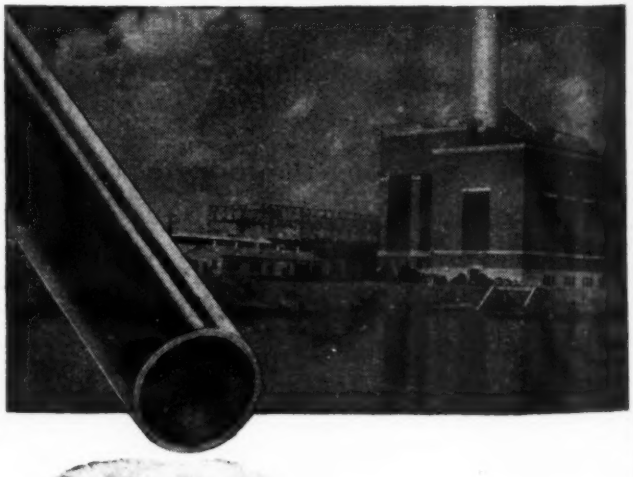
The factors discussed above should be taken into consideration by operators who contemplate buying condenser tubing.

When considering retubing, the operator who has had years of experience with his condenser or heat exchanger and who has kept careful performance records is in a position to use the above factors to obtain tubing which will give him greater efficiency and economy than he was able to obtain from his previous installation.

Your nearest Bridgeport Office will be glad to cooperate in making available the full resources of Bridgeport's laboratory to help you select the proper tubing.

Condenser Tube Manual

In the meantime, write for 112-page condenser tube manual; 39 photographs, 29 diagrams, 23 tables, corrosion research data, specifications for modern tubing alloys.



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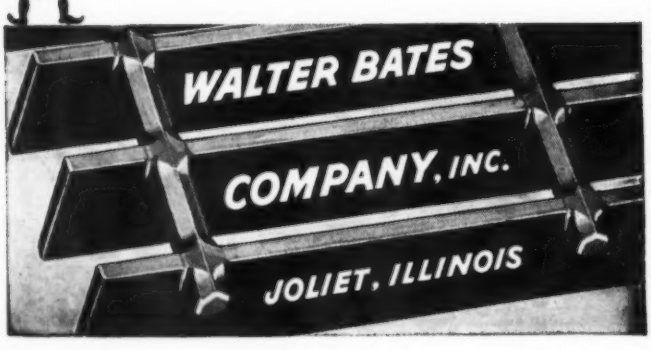

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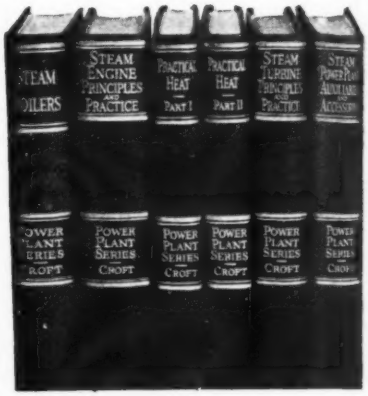
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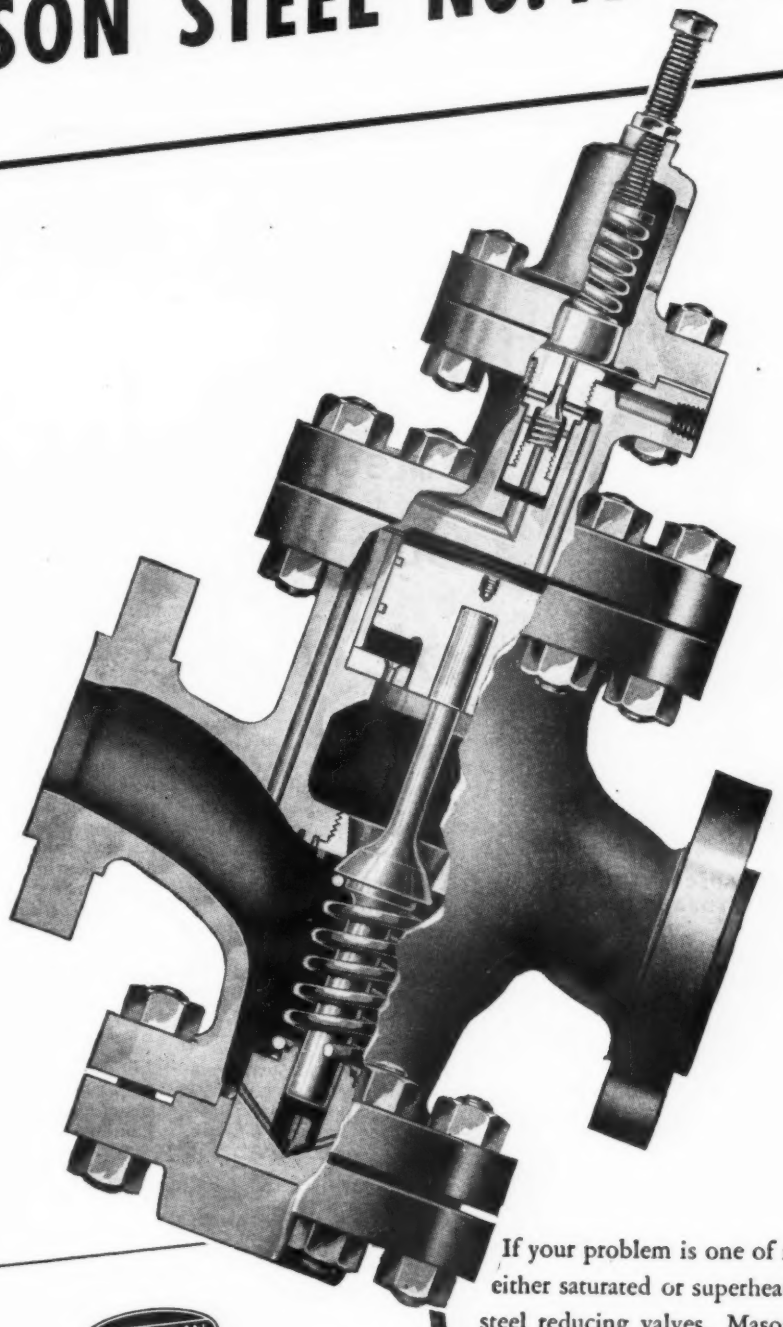

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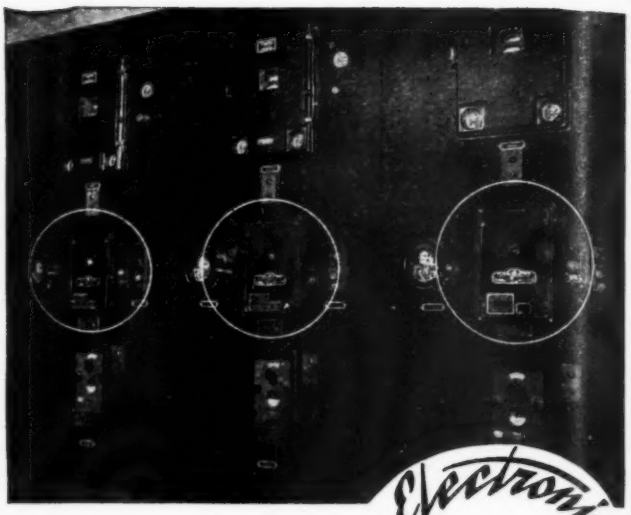

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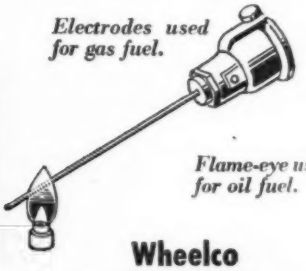

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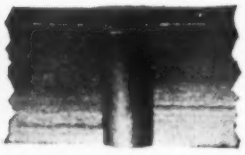
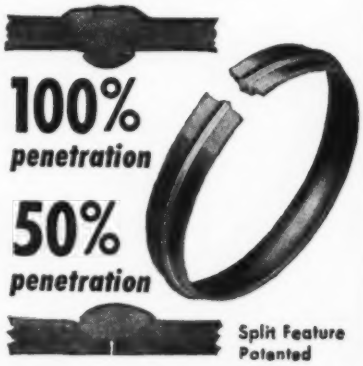
and you can use LIGHTER walled pipe

There are two outstanding advantages, in addition to several others, in using WEDGE Chill Rings with the patented SPLIT Feature for welding pipe joints. They assure 100% PENETRATION of the ENTIRE circumference of pipe. LIGHTER walled pipe can be used because WEDGE Chill Rings REINFORCE the joints and for that reason thinner pipe can be safely used. This reduces the cost and also the weight. If you weld pipe it will pay to investigate.





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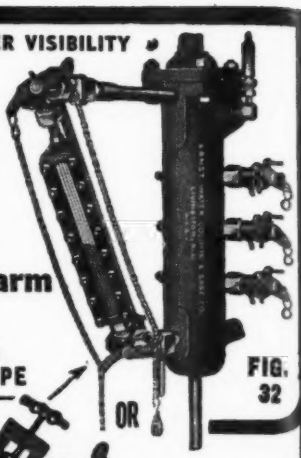
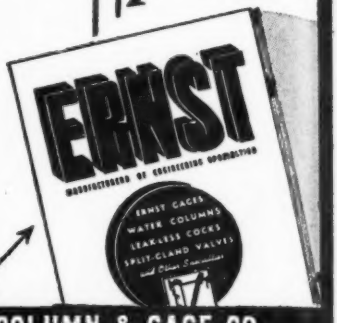


FIG. 32

OR

SPLIT GLAND TYPE

FIG. 1



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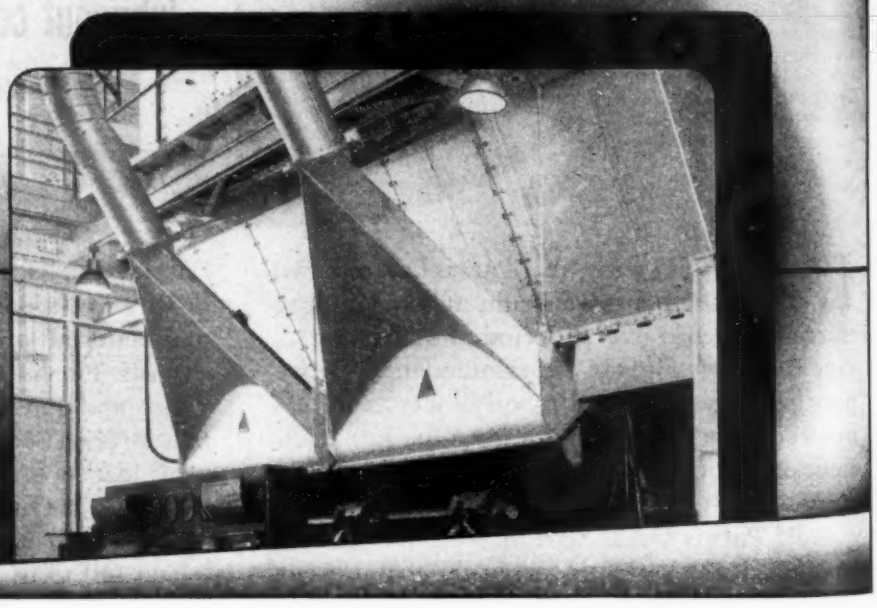

This quote, taken from an article on coal sizing, published recently in COMBUSTION, was listed as a "must" for the efficient burning of coal on stokers. To avoid segregation in your coal feeding system install CONICAL Non-Segregating Coal Distributors as made by S. E. Co. Their design is based on sound scientific principle and *they will eliminate segregation.* Write for full details. Address—Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio

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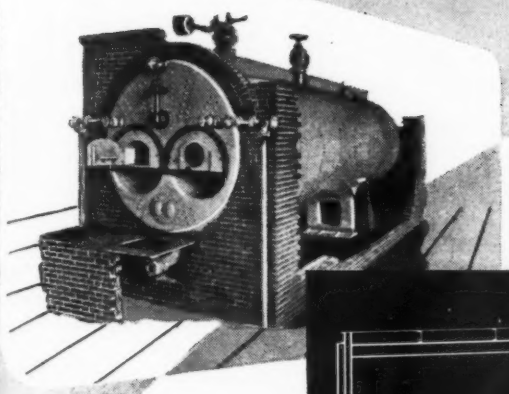
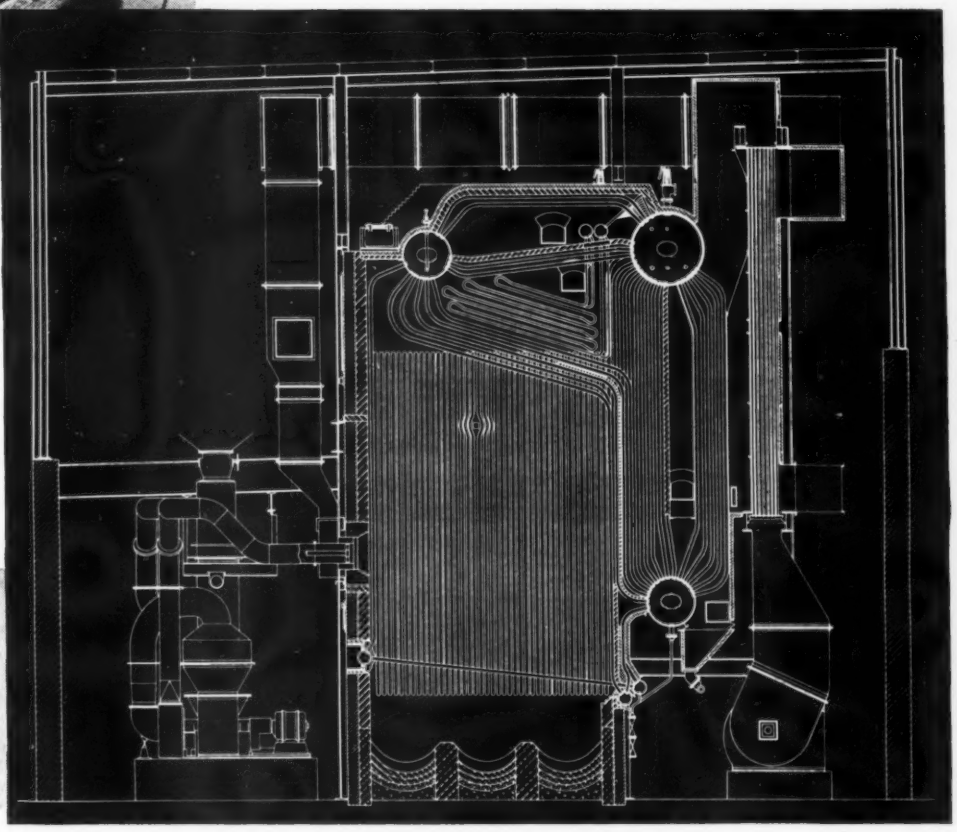
Edge Moor
water tube boilers—



The Edge Moor Improved Galloway Boiler of the 1880's. It was described as "an internally fired boiler with two furnaces, uniting into one common central flue, which flue contains numerous conical tubes that cross the flue in nearly vertical lines."



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Down through the years since 1878, Edge Moor has continued to contribute to the store of knowledge and experience gained in the building of steam generating equipment. Modern demands are for continuous service and high ratings with maximum operating efficiency. Edge Moor meets these demands through a combination of skillful design, carefully selected materials and unsurpassed workmanship.

Edge Moor boilers are built in all standard designs of any required capacity, for drum pressures up to 900 lbs., and adapted to all methods of firing both solid and liquid fuels. Auxiliaries include water cooled furnaces, superheaters, economizers, air preheaters and steam washers. Complete installation service is available.

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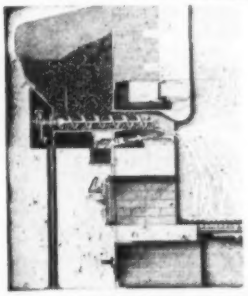

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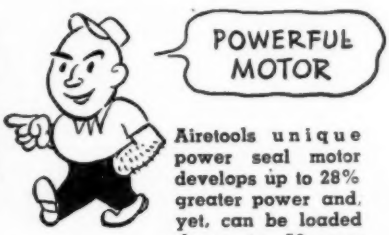

Airetools unique power seal motor develops up to 28% greater power and, yet, can be loaded down to 50 rpm without stalling. Constant torque at low speeds. Picks up immediately when load is released. Slip fit construction for easy maintenance. For tube sizes ½" to 24" I.D.; straight or curved.

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70/30 for CO_2 and O

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SERVICE CONDITIONS INDICATE WRONG ALLOY

Further investigation developed that the condensate on the outside of the tube contained relatively high amounts of carbon dioxide and oxygen and that there was mild erosion of the tube surface near the tube sheet where maximum flow of the condensate occurs.

Copper is not recommended where erosion may be a factor, so this customer's problem was solved when Scovill recommended 70/30 Cupro-Nickel tubes. In less severe service conditions, an inhibited Admiralty Metal such as Phosphorized Admiralty would resist this type of corrosion better than the copper tubes originally installed.

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John Zink BI-MIX BURNERS make ideal combustion installations for refining and processing.

BI-MIX BURNERS are all in one piece, installation is simple; they are just bricked into wall or floor of furnace. They burn with a short flame without the use of small ports refining gases, natural gas, oil vapors or a mixture of gases. Slugs of water, oil or gasoline blowing through them or running down over them do not damage the burner.

John Zink BI-MIX BURNERS will produce just about any type of heat pattern desired—Heat in front of the furnace—Heat in back of the furnace—Heat in the center of the furnace—or Uniform Heat throughout the furnace.

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Squires

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Reliability and economy are among its popular points and besides Squires Traps positively will not wire draw.

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because of the

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Short Center Drives

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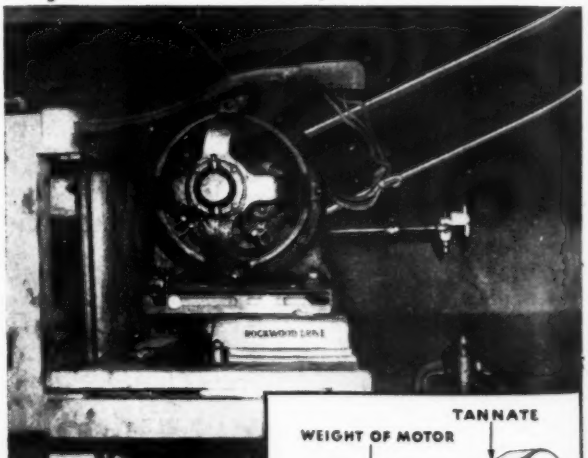

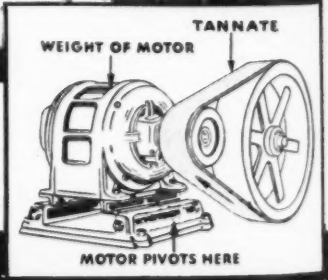

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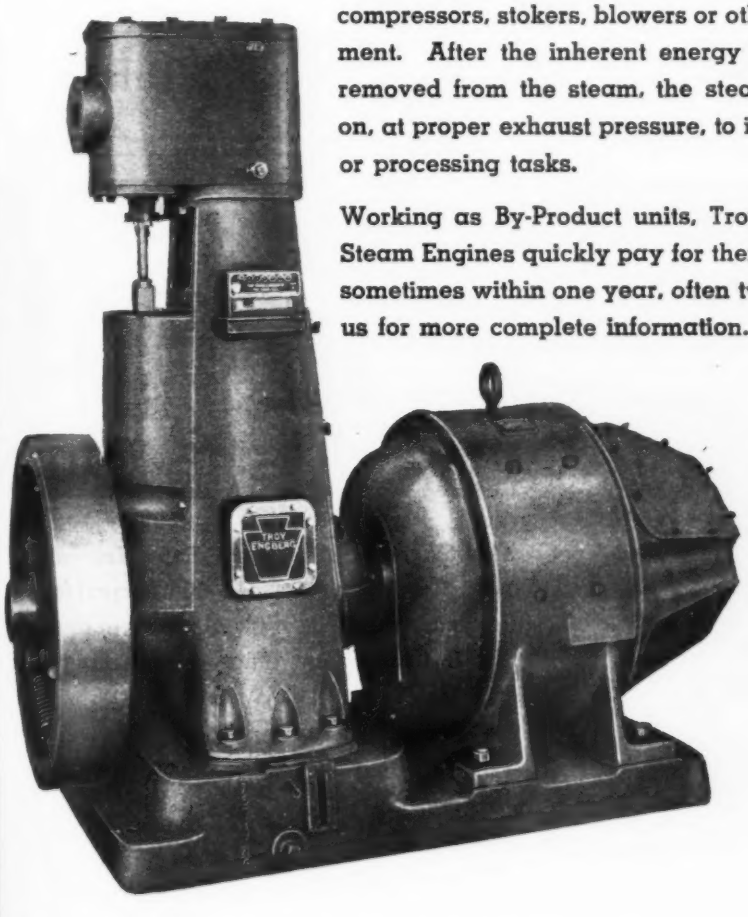

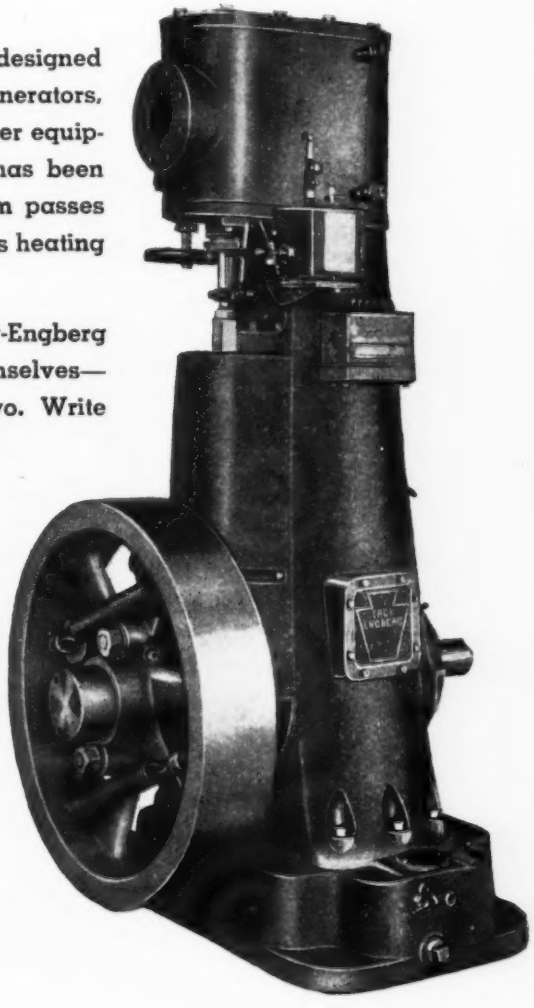

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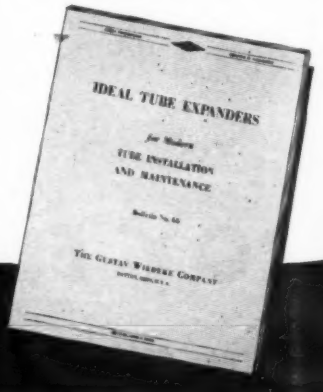

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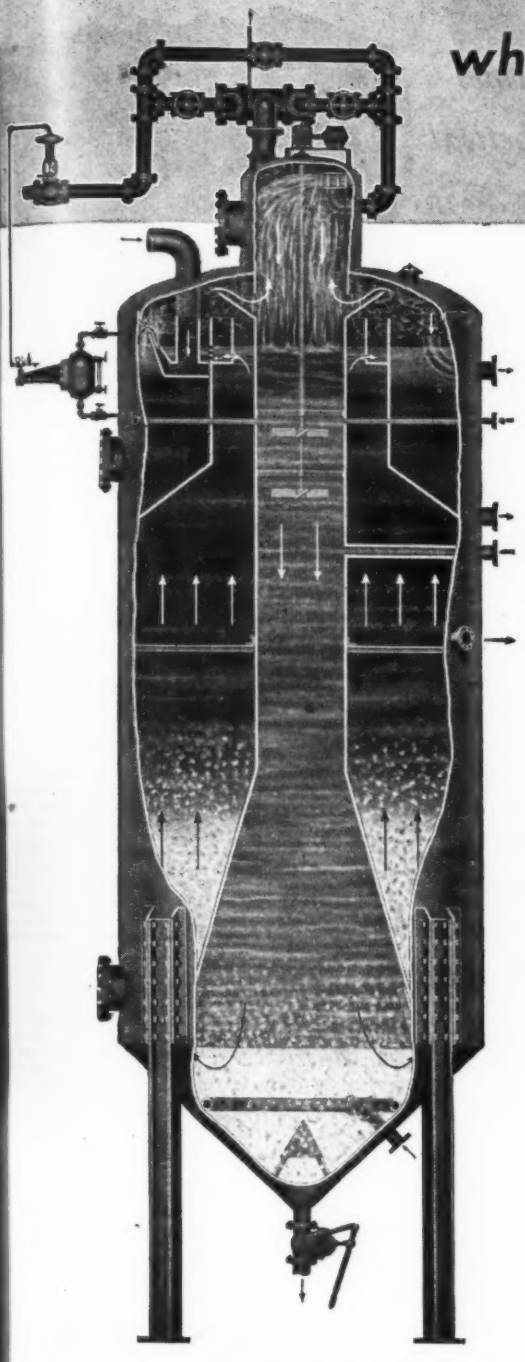
Don't overlook these points

when buying a HOT PROCESS WATER SOFTENER



The basic principles of a Hot Process Water Softener are essentially the same regardless of who manufactures it. The difference lies in the engineering and application of these principles and in the design and manufacture of the equipment itself. It's the difference between *economical efficiency* and *costly inefficiency*.

If you are studying designs of various makes of Hot Process Water Softeners you'll find it worthwhile to give careful thought to these points:

1. ***Rate of velocity in the zone where chemicals are added. The velocity must be high to insure thorough mixing.***
2. ***Rate of velocity in the second zone where floc begins to form. Here the velocity should be reduced to permit coagulation of finer particles and prevent floc from breaking up.***
3. ***Rate of velocity in the third zone. In this zone a low velocity is essential to insure effective settling action and efficient filtration.***
4. ***Thicknesses of the heads and shell and the corner radii of the heads, which affect the life of the unit and the safety of your personnel.***
5. ***Amount of surface in the vent condenser or condensers which is a criterion of the efficiency of the unit.***
6. ***Sizes of the inlet and outlet and other connections.***
7. ***Amount of free surface in the clarification zone which has a direct bearing on the length of filter runs.***

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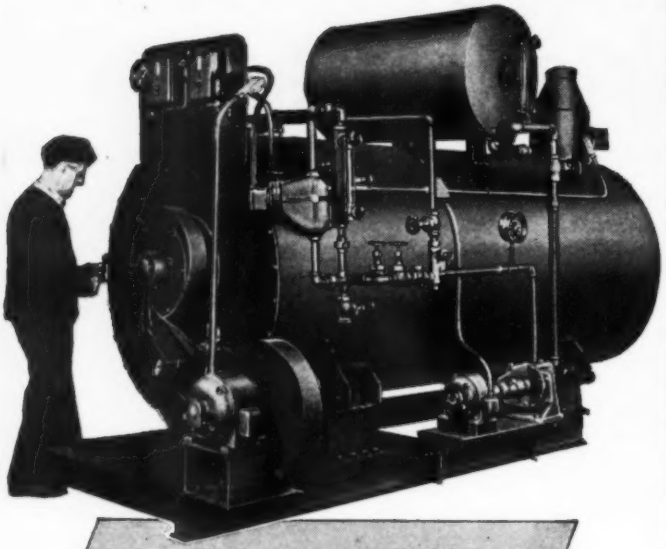

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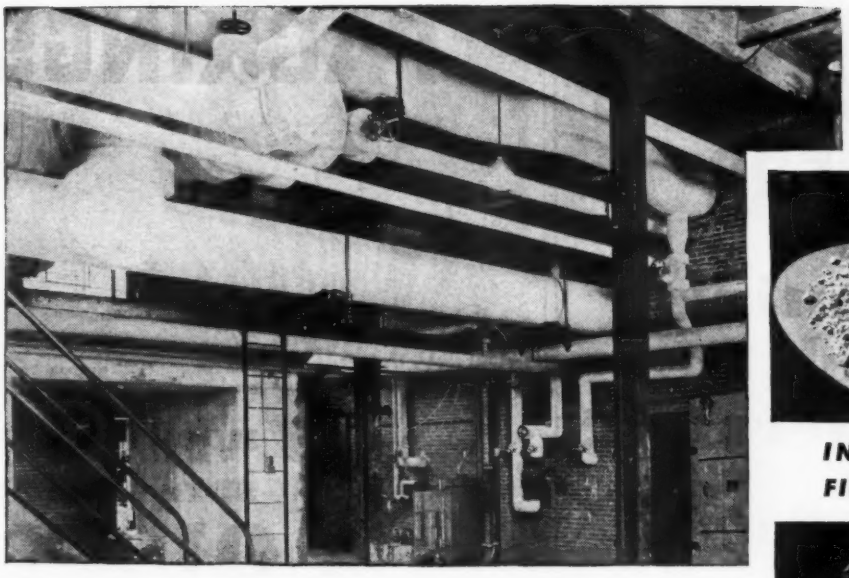

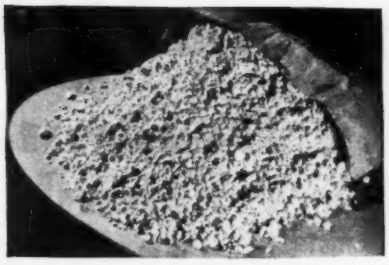

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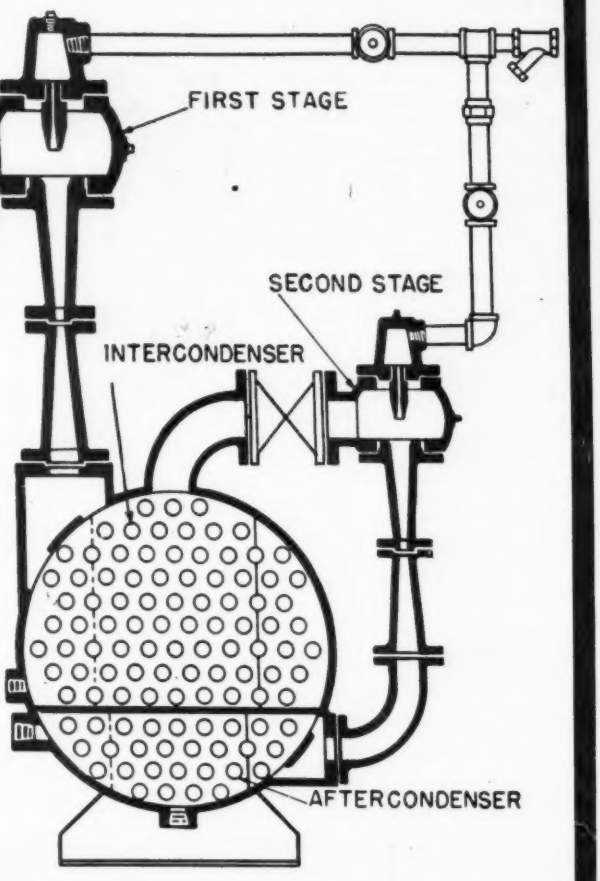

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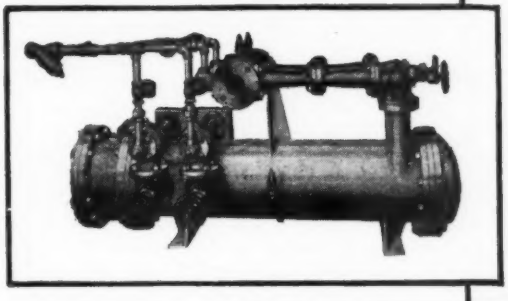

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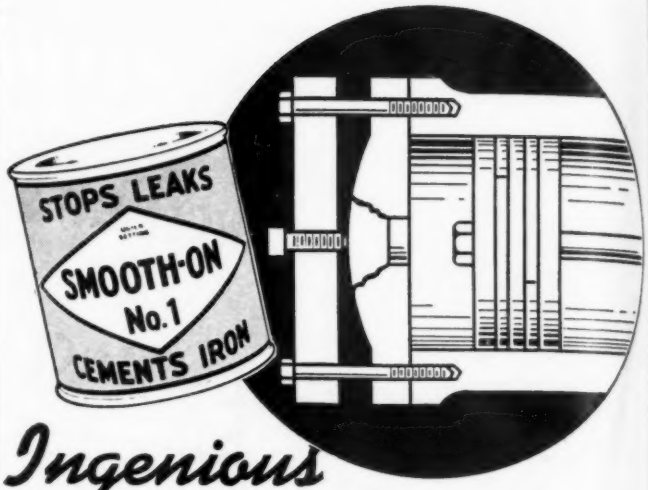

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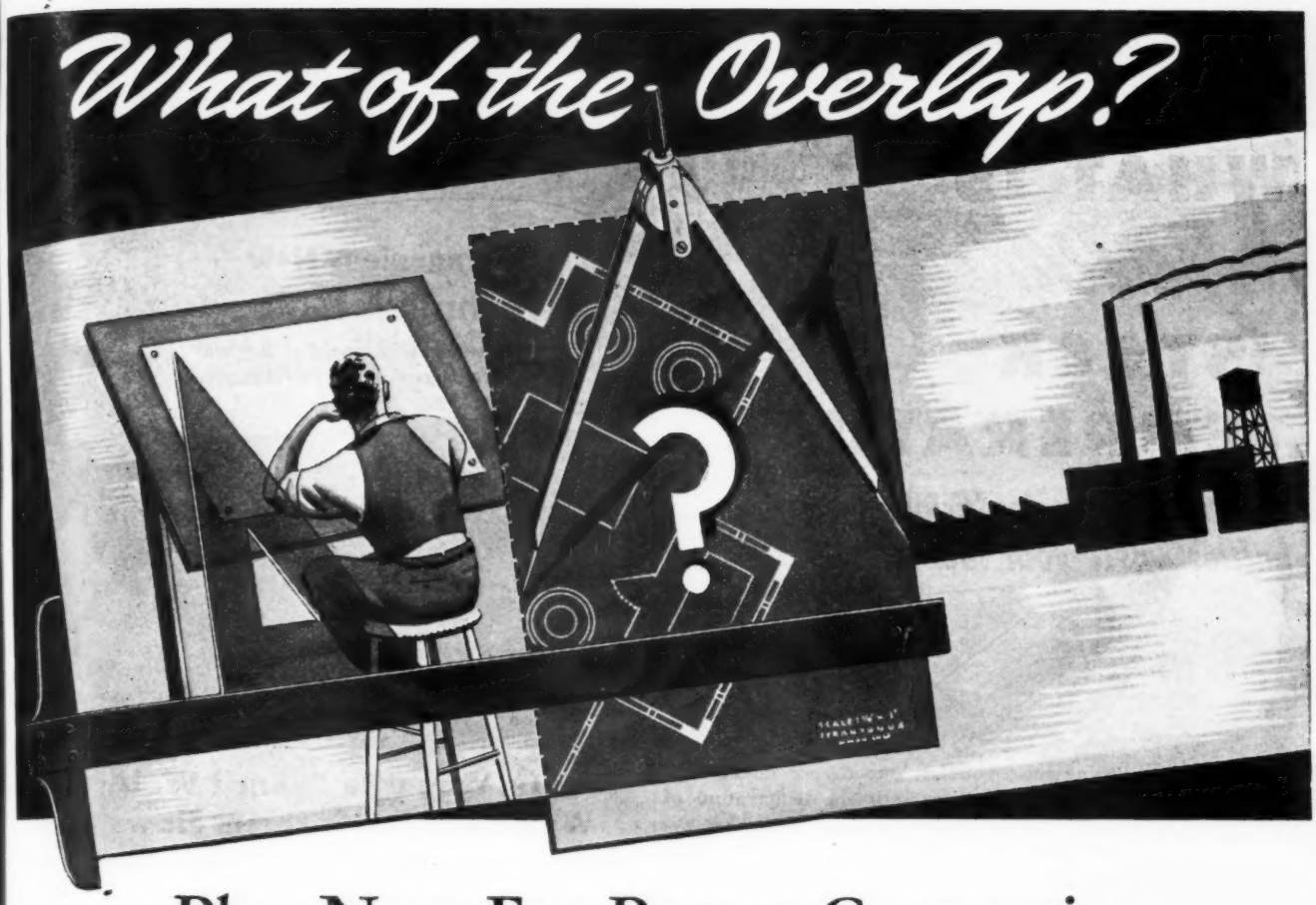

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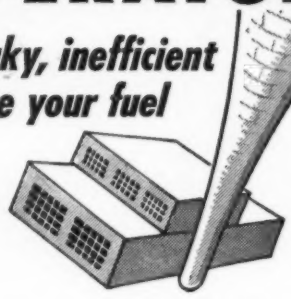

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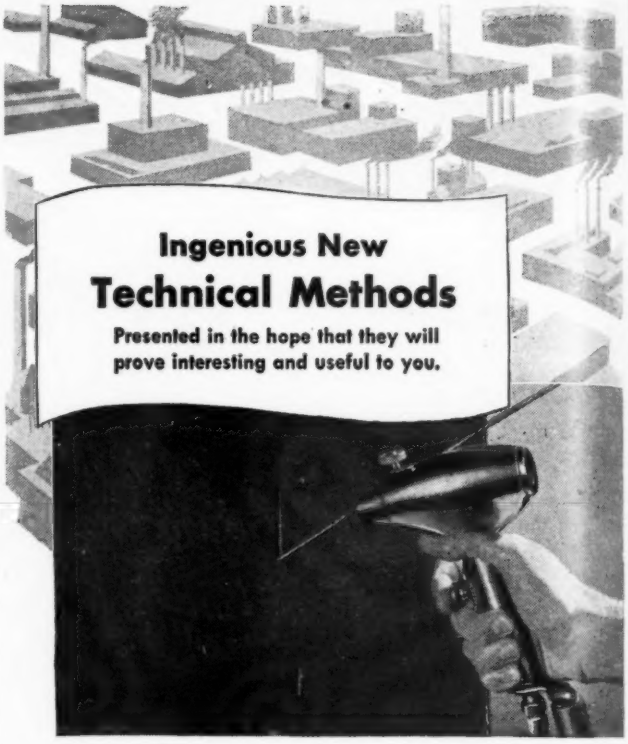

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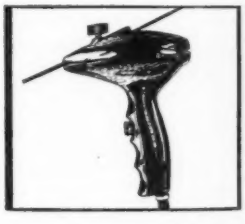
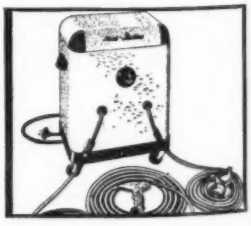


Close-up of new Pencil Weld Gun



Pencil Weld Gun with Vibra-Weld Transformer

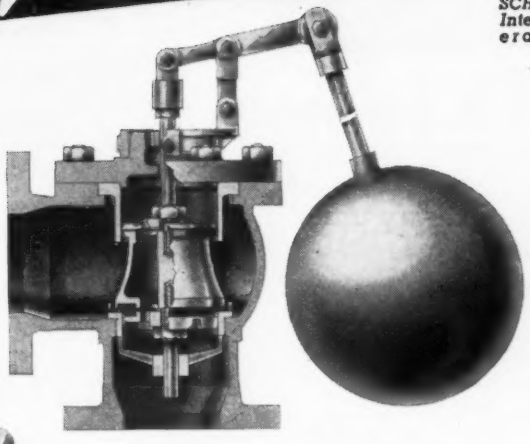
Unavailable, however, is Wrigley's Spearmint Gum. As the makers of Wrigley's Spearmint are unable to continue manufacture of the product up to their quality standards under present conditions, the only unqualified protection they can give to the consumer and the dealer alike is to keep the Wrigley's Spearmint wrapper empty. While they advertise this empty wrapper, none is being made and any found on the market is old production of a perishable product.

You can get complete information from Mid-States Equipment Company, 2429 S. Michigan Avenue, Chicago 16, Illinois

Z-67

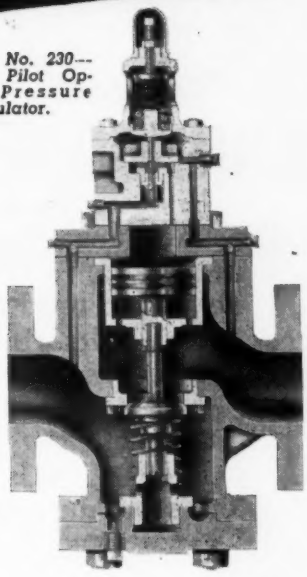
NOW is the time...

to Solve Your Control Problems

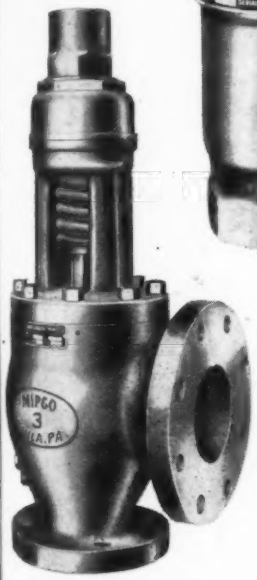


SCHADE No. 7—Single Seated, Balanced Float Valve.

SCHADE No. 230—Internal Pilot Operated Pressure Regulator.

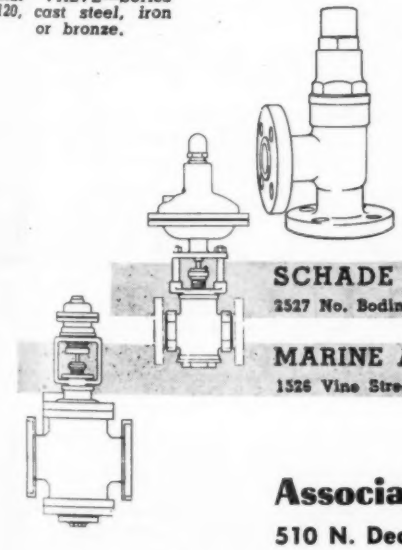


MIPCO CLASS L RELIEF VALVE—Series 50, forged steel threaded ends.



MIPCO CLASS L RELIEF VALVE—Series 120, cast steel, iron or bronze.

"GETTING SET" today is going to be an important advantage tomorrow. If your plans involve controls, you'll find valuable help in the pooled experience of the combined engineering staffs of "Associated Companies." This broad control engineering assistance is available to you without obligation. Why not use it. Write us—NOW is the time.



Controls illustrated are products of

SCHADE VALVE MANUFACTURING CO.
2527 No. Bodine Street — Philadelphia 33, Pa.

MARINE AND INDUSTRIAL PRODUCTS CO.
1526 Vine Street — Philadelphia 2, Pa.

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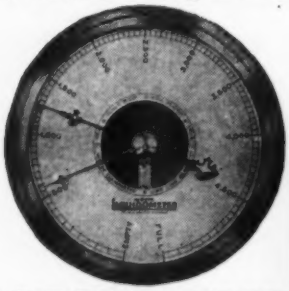
an associated company

THOSE WHO CAN'T AFFORD TO MAKE ERRORS IN MEASURING VALUABLE STORED LIQUIDS CHOOSE—



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"THEY'RE ALWAYS DEPENDABLE"

100% automatic.

No pumps, valves, or auxiliary units needed to read them.

Models available for either remote or direct readings.

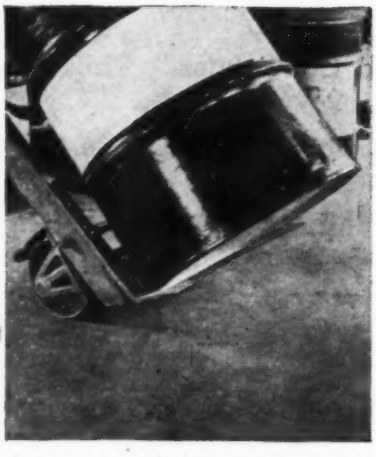
Accuracy unaffected by specific gravity of tank liquid.

Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

THE LIQUIDOMETER CORP
33-16 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.

Keep Floors Level—Speed Traffic with *Quick-Floor*

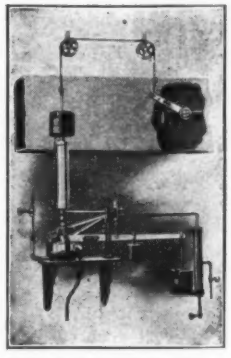


Use it to repair Chuck Holes • Cracks • Worn Aisles • Ramps • Welding Room Floors • Around Re-set Machines • And for Complete Resurfacing Inside or Outside

QUICK-FLOOR is ready-mixed—is easily laid (a square foot a minute)—sets by pressure—requires no drying time—can be used as soon as laid—outwears the original concrete. Unconditionally guaranteed. Write or phone today for help on your specific problems.

Quick-Floor
Made By DURA-TRED COMPANY
351 N. Central Park Blvd. • Chicago 24, Ill. • Van Buren 2171

WHY LEADING ENGINEERS INSIST ON LOCKE VALVES AND VALVE REGULATORS



Here is the most sensitive regulator ever built, the LOCKE HYDRAULIC REGULATOR (numbers 1 and 2). A movement of 2/1000 of an inch secures operation. Speed of operation is obtained and regulated by the discharge valve behind water motor.

★ ★ ★ ★

Traditional reliability, maintained for 75 years, establishes Locke as the leader in the design, manufacture and installation of regulators. Engineers who know, always specify LOCKE for standard and specialized duties. Locke is the absolute synonym for dependability in this critical and important phase of heating and ventilating. A Locke-trained engineer is at your service.

A catalog will be forwarded upon your request.

DIVISION OF THE H. T. WILSON MACHINE CO., INC.

LOCKE REGULATOR COMPANY

WALTER AND OSBORNE STREETS
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MODEL REGULATORS • DAMPER REGULATORS • FAN ENGINE REGULATORS • BACK PRESSURE VALVES • BALANCED VALVES • ELECTRIC VALVES • REDUCING CONTROLS FLOAT CONTROLS • PILOT CONTROLS • PUMP GOVERNORS • VACUUM BREAKERS ENGINE STOPS • MASTER REGULATORS • OIL CONTROL VALVES • SOLENOID CONTROLS

THE ONLY RAINBOW SHE KNOWS IS THE ONE WITH THE POT OF GOLD!
DAMES SURE GET THE OLD BOY DOWN
IF HE TOLD HER ABOUT RAINBOW'S TRADEMARK OF 11 ROWS OF DIAMONDS -SHE'D THINK HE WAS PROPOSIN'-
THE BOSS SURE GETS STEAMED UP WHEN THEY DON'T USE RAINBOW!
WHY DID THIS HAVE TO HAPPEN TO ME?
BUT I THOUGHT ALL RED PACKINGS WERE ALIKE!
YOU CAN DEPEND ON RAINBOW

56 Years

OF DOING A BETTER PACKING JOB

When you're fighting a war, any production delay is serious. That makes Rainbow, the original red sheet packing, more valuable than ever. For Rainbow has been for 56 years the packing that will not squeeze or blow out in service.

Rainbow is designed for packing against hot or cold water, air, saturated steam pressures up to 150 pounds, and all hydraulic conditions. It insures a tight joint, fills up irregularities in the flange, overcomes normal vibration, expansion and contraction in a line.

Help keep your production steady —use Rainbow, the original red sheet packing.

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program, CBS network, Sunday afternoon, 3:00 to 4:30 E.W.T.

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End Pump Troubles!

HILL IMPROVED PUMP VALVES

• The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate. Send today for bulletin that tells how to get better pump performance.

HILL PUMP VALVE CO.
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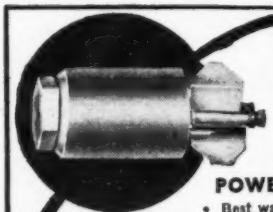

STEP UP POWER NOW WITH A MOHAWK POWER SCRAPER

• Best way to remove soot, slag from boiler tubes. Baked slag quickly scraped and blown out by the Mohawk! Actually burnishes tubes—cannot possibly harm them. Uses steam or air For all size fire tubes. Also inquire about Vibratap Tube Cleaners for removing scale from fire and water tubes.

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60 S. DIVISION ST., BUFFALO, N. Y.

"MONO" BOILER BAFFLES HIGH TEMPERATURE Refractory Cements

SANFORD C. SMITH REFRACTORIES, INC.
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By reason of special training, wide experience and tested ability, coupled with professional integrity, brings to his client detached engineering and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert.

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Power Plants — *Engineers* — Consultation
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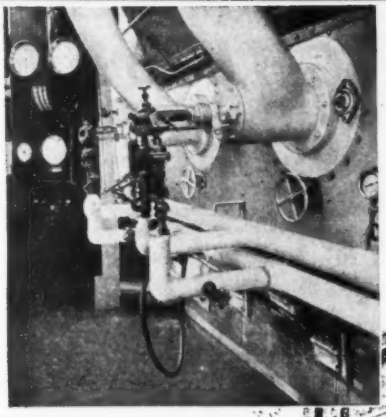
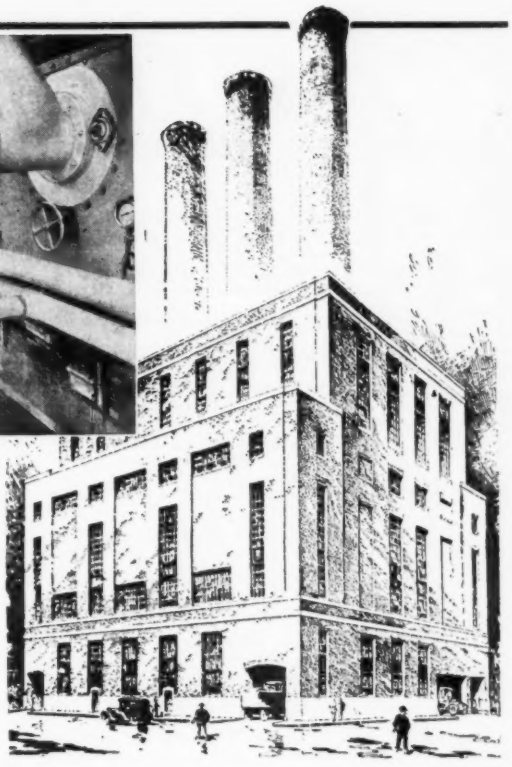
A Really Satisfactory means of firing Large Steam Boilers

NATIONAL AIROIL
Type SAL
FUEL OIL BURNERS





NATIONAL AIROIL FUEL OIL - GAS BURNERS

The SAL has solved a fuel problem for a number of plants by providing an alternate to pulverized coal, coke or natural gas . . . in boilers up to one million pounds per hour steam capacity.

It will efficiently burn up to 600 gallons of heavy oil per hour . . . which is about 90 million B.T.U.

Little maintenance is needed on the SAL aside from an occasional cleaning.

Why not let us apply our 33 years experience in the manufacture and application of fuel oil and gas burners to your combustion problems.

NATIONAL AIROIL BURNER Company, Incorporated
1250 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PENNA.

OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS • EXPLOSION DOORS
ACCESS DOORS • AIR DOORS • BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

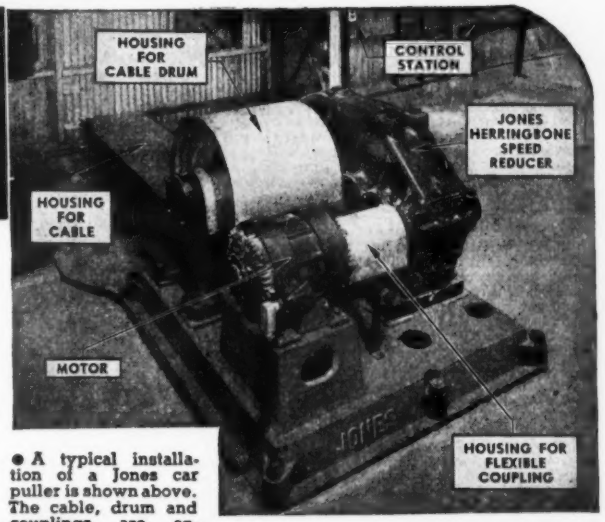
For spotting your cars- JONES CAR PULLERS

YOU will be surprised how much time can be saved in the spotting and switching of cars by using a Jones car puller. These sturdy, compact units will speed up car handling to the point where they soon pay for themselves in the saving of time and labor.

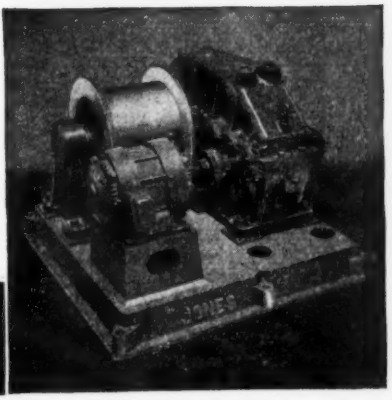
These car pullers are built by Jones as complete units with motor included if desired, or with base to take standard motor, as supplied by the purchaser. The cable drum is driven by a Jones triple reduction Herringbone speed reducer and the control station may be located at a point to give the operator a clear view of the tracks and spotting positions.

Even in plants where comparatively few cars are handled it has been found that a Jones car puller more than pays its way. Prices and complete information will enable you to judge whether such an outfit might pay out in your plant. Write for complete information.

W. A. JONES FOUNDRY & MACHINE CO.
4423 Roosevelt Road, Chicago, Illinois



• A typical installation of a Jones car puller is shown above. The cable, drum and couplings are enclosed by sheet metal housings as an extra precaution in this installation to eliminate all hazard from moving parts.



• A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES

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PROPOSALS, 75 cents a line an insertion.

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BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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The advertising rate is $7.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. P.

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POSITIONS VACANT

WANTED: EXPERIENCED draftsmen, preferably familiar with beet sugar factory design. Duration of project approximately one year. Location middle west. Give particulars as to education, experience, military status. State salary expected. References. Must have U.S.E.S. clearance. P-805, Power, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL DRAFTSMEN and engineers experienced in steam power plant design and detailing work. State age, experience and salary desired. WMC rules apply. Write P-808, Power, 520 N. Michigan Ave., Chicago 11, Ill.

OPENING FOR an architect qualified to design industrial buildings particularly those related to the refrigeration industry. State qualifications, experience, and salary expected. Location, Wichita, Kansas. P-823, Power, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED: FUEL Engineer for 12,000 H.P. High pressure boiler plant located in Northern Ohio. Technical graduate with several years experience preferred. Assume full responsibility for the selection and testing of coal. Good prospects for advancement in a long established, stable, and growing company. Liberal starting salary for qualified engineer. All replies strictly confidential. P-824, Power, 520 N. Michigan Ave., Chicago 11, Ill.

FIRE PROTECTION Engineers and inspectors. Technical graduates, especially chemical and electrical; civil, mechanical, metallurgical also considered. Inspect and consult industrial plants to prevent fires, explosions, and other casualties. Considerable travel and report writing; interesting work offering permanency. Engineering experience necessary. Salary open. Well-known national organization with openings at Cleveland, Chicago, and other district centers. Men under 34 years of age cannot be considered. Please send a photograph when applying. P-836, Power, 330 W. 42nd St., New York 18, N. Y.

DRAFTSMAN, permanent position, for equipment, utilities, and building work, by essential chemical manufacturing plant, 55 miles N.W. of Chicago. Please furnish particulars of age, education, experience, references, salary requirement, and photograph in reply. P-837, Power, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED: MECHANICAL and structural designer-draftsmen, thoroughly experienced in steam-electric power plant design and including piping and other related detailing. Work on drafting board. Send synopsis of training and experience including references, representative samples of design and draftsmanship, salary desired and earliest date could report for employment in Consulting Engineer's office. Location North Carolina. WMC regulations apply. P-838, Power, 330 W. 42nd St., New York 18, N. Y.

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SALARIED POSITIONS — This advertising service of 35 years recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

ENGINEER holding National Board and several state commissions engaged at present by insurance company as inspector of boilers and machinery, including electrical equipment, desires position as supervising engineer. PW-839, Power, 520 N. Michigan Ave., Chicago 11, Ill.

ENGINEERS and DRAFTSMEN

Electrical—Mechanical—Structural

We have openings for capable engineers and draftsmen in the following branches of engineering—

ELECTRICAL—Industrial lighting, Power distribution, and Electronic controls and devices.

MECHANICAL—Power plants, Heating systems, Process piping, Conveying systems, Plumbing, Sewers, Sprinkler work, and Precision machine design.

STRUCTURAL—Industrial buildings, Power plants, and Miscellaneous structures of steel and reinforced concrete.

Opportunities are in the West Coast, Cleveland, Chicago, New York and Gulf Coast areas.—Vital war plants important to the United States Government under high priority ratings.—Recent graduates will be considered.

Applicants must conform with Local War Manpower Regulations.

THE AUSTIN COMPANY

National Headquarters

16112 EUCLID AVENUE **CLEVELAND, OHIO**

Steam Plant Superintendent

To take complete charge of operation of new high pressure oil-fired boiler plant and steam distribution system to process. Must know water treatment for boiler feed and handling of high temperature condensate system.

Salary commensurate with responsibility.

P-835, Power
520 North Michigan Ave., Chicago 11, Ill.

WANTED

Project Engineer

Engineering and contracting firm catering to petroleum, gas, chemical and power industries needs chemical or mechanical engineers to be responsible for complete projects from flow sheets to termination of construction. Must cooperate with process engineers, drafting room, purchasing department and construction division and aggressively coordinate work through these departments. Must be proficient in thermodynamics, instrumentation and know mechanical equipment. Salary commensurate with ability. Location, Kansas City, Missouri. Applicants must have U.S.E.S. clearance.

P-821, Power
520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL DESIGNERS

Experienced in Power, Industrial, and Processing Plants.

EBASCO SERVICES, INC.

2 Rector St. **N. Y. C.**

Don't forget the

BOX NUMBER

When answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

POSITIONS WANTED

(Continued from opposite page)

LET AN Engineer solve your steam power plant and blast furnace problems. Experienced combustion and instrument man. Seventeen years in large power plant and blast furnace work. All problems thoroughly analyzed. Full or part-time. PW-840, Power, 330 W. 42nd St., New York 18, N. Y.

WANTED Position as chief engineer of an industrial power plant. Thoroughly qualified. Ohio first class steam engineers license. 27 years operating maintenance and supervisory experience. Thorough knowledge of refrigeration and air conditioning. PW-828, Power, 520 N. Michigan Ave., Chicago 11, Ill.

SALESMEN WANTED

SALESMAN for New England area to handle complete line of industrial oil burning and stoker equipment. Salary, expenses or commission. State experience. SW-841, Power, 330 W. 42nd St., New York 18, N. Y.

PROMINENT STATIONARY and marine diesel engine manufacturer recruiting junior salesmen—preferably Ex-Servicemen with technical and practical experience. Give full information. Confidential. SW-829, Power, 330 W. 42nd St., New York 18, N. Y.

ARE YOU REPRESENTED IN NEW ENGLAND?

Established New England Firm handling equipment for power and manufacturing plants and marine trade desires additional Line.

RA-833, Power
330 W. 42nd St., New York 18, N. Y.

Watch—
the *Searchlight Section*
for
Equipment Opportunities

EXPERIENCED

INDUSTRIAL SALESMAN

If you are over 38 with proper qualifications and seek a permanent connection with a real future with one of the country's recognized leaders in the industrial maintenance field we offer you: $50 weekly guaranteed drawing account with a contract assuring attractive income. Established territory. Nationally known line vital to war interest. No shortages or priority problems. Protection on repeat business. Our men make from $6000 to $9000 per year and more. Our products are essential because they maintain wartime plant efficiency and will be equally important after the war. The service rendered by our men is considered essential. They receive gasoline and tires needed. Write full details stating products sold for personal interview.

THE NORTH AMERICAN PRODUCTS COMPANY
Cleveland 13, Ohio

SALES ENGINEER

Offers to represent good line of power plant equipment on exclusive agency basis.

Has thorough experience with steam and power generating equipment and accessories. Good sales record and contacts in Metropolitan New York area.

RA-787, Power
330 W. 42nd St., New York 18, N. Y.

INSTRUMENTS REPAIRED REBUILT AND RECALIBRATED

Large List of Used Switchboard, Indicating and Recording Instruments on hand.

ENGINEERING EQUIPMENT CO.
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FOR SALE

1375 H. P.
McIntosh & Seymour
Diesel Generating Plant
3/60/480—2300

1—1000 K. V. A.
1— 372 K. V. A.

Can be seen Operating
Rebuilt & Guaranteed

Robert Schoonmaker
Diesel Sales Engineers
Port Washington Long Island, N. Y.
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PRICED TO SELL FAST!!

TWO, 5,000 KW Westinghouse
TURBO GENERATOR SETS

13,800 V., 25 Cy.

In excellent condition
Can be inspected in operation.

IRON & STEEL PRODUCTS, INC.
13438 S. Brainard Ave., Chicago 33, Illinois
"*ANYTHING* containing IRON or STEEL"

WANTED

WANTED
Condensing Turbine-Generator
750 to 1250 KW Capacity, 2300 v. 3 ph. 60 cy. with direct connected exciter, for operation 150 psi. Not over 15 years old. Give full particulars re same and any available condensing equipment.
ALBERT C. WOOD
Stock Exc. Bldg. Phila. 2, Pa.

WANTED
Bedplate & 2 Piece Main Frame
500 HP. De La Vergne Diesel Engine 5 cylinder, 17x24, 225 RPM. or complete engine if in sound condition.
W-834, Power
330 West 42nd St., New York 18, N. Y.

WANTED
G.E. or Westh. A.C. Generator
in good condition
600 K.W. 240 R.P.M. 3 Ph. 60 Cy. 600 vt.
Direct connected exciter
One recent type Lombard or Woodward water wheel governor 9,000 foot pound
W-830, Power
330 West 42nd St., New York 18, N. Y.

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find equipment you need
"Searchlight" Advertising

Cash Ready
FOR YOUR
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Electric motors, AC and DC.
Compensators
Generators
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Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment
Send us list with full details
WIRE OR PHONE
POWER EQUIPMENT CO.
154 ANDREWS ST., ROCHESTER 4, N. Y.
Telephone Main 568 or 569

WANTED
Motor Generator Set Synchronous
2300 Volt AC to 230 Volt DC. Complete with panel boards & starting equipment.
TEXTILE PRINTING CO.
Bondsville, Mass.

FOR SALE
One Brine Cooler—Six Pass—horizontal steel tubes
One Hayward Clamshell Bucket Type "E" ¾ yd. cap.
One 10" Centrifugal Pump
One 12" Centrifugal Pump
Also steam pumps, valves, etc.
W. L. BROADDUS
Hopewell, Va.

See
Pages 334 to 353
for
additional
advertising
of
Equipment
For Sale

HI-LIGHTS OF *Hemphill* VALUES!

YOU often come up against some knotty problems of what to buy and how to use it best, in considering Used or Rebuilt Equipment. That's what our graduate Electrical Engineers are here for—to help you unravel the knots quickly and at least cost. That's another angle of the reasons why with men who know EQUIPMENT values best—it's "Hemphill for Power."

Advisory Service

Customers often find it well worthwhile to consult Hemphill Engineers as to "the best way to do the job," of selecting and utilizing equipment, no matter how small or how big and complex.

The Hemphill SEAL OF QUALITY GUARANTEES ENGINEERED RECONDITIONING

MOTOR—3 PHASE 60 CYCLE

1—500 HP, 900 RPM, Lincoln, 440 volt, slip ring.
1—400 HP, 1200 RPM, 220 volt, Westinghouse squirrel cage.
1—350 HP, 300 RPM, 440 volt, General Electric slip ring.
1—200 HP, 600 RPM, 2200 volt, G.E. sl. rg.
1—150 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
1—150 HP, 1750 RPM, Westinghouse, sl. rg.
1—150 HP, 400 RPM, 440 volt, General Electric squirrel cage.
1—125 HP, 1800 RPM, 2200 volt, Continental, squirrel cage.
1—100 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1— 90 HP, RPM, 550 volt, Cr. Whlr. sq. cg.
1— 75 HP, 1200 RPM, 440 volt, G.E., slip ring.
1— 75 HP, 900 RPM,4000 volt, Elec. Mach. syn.
1— 75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1— 75 HP, 1200 RPM, G.E., sl. rg.
2— 75 HP, 900 RPM, G.E., sl. rg.
1— 60 HP, 1200 RPM, 220 volt General Electric, slip ring.
1— 50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1— 50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D. C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1— 80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1— 75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.

MOTORS—D.C. 230 VOLTS (Con't)

8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—30 HP, 750 RPM, G.E., Type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
1—15 HP, G.E., 800 RPM, Type RC-11.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—60 HP, 500/1000 RPM, Diehl.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
1—25 HP, Westinghouse, 650/2200 RPM, Type SK-1101L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
3—11½ HP, 500/1500 RPM, Westinghouse.
1—10 HP, 400/1600 RPM, Westinghouse.
1— 5 HP, 600/1200 RPM, General Electric.
1— 5 HP, 450/1800 RPM, Crocker Wheeler.
1— 5 HP, 400/1600 RPM, Diehl.
1— 3 HP, 225/900 RPM, Electro Dynamic.

MOTOR GENERATOR SETS

1—75 KW, 125 volt, General Electric, squirrel cage.
1—20 KW, 600 volt, General Electric, squirrel cage induction motor.
2—15 KW, 250 volt, General Electric, squirrel cage.

TURBO GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v. con.
1—200 KW, G.E., 3 ph., 60 cy., 220 v. cond.
1— 30 KW, 135 volt, Allis-Chalmers non-condenser.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 2300 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis-Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis-Chal.

TRANSFORMERS

2—400 KVA, G.E., 4156-250/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—150 KVA, G.E., 33000/2300/4000 Y.
2—100 KVA, General Electric 2200/220/440 volt.
3—100 KVA, Westinghouse, 11,430/250 volts.
3—100 KVA, Westinghouse, 13200/250 volts.
3— 75 KVA, Westinghouse, 2200/220/110 volts.
3— 75 KVA, G.E., 13,500-750/440 volts.
1— 75 KVA, G.E., 3 phase, 4156Y—120/208Y.
2— 50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
2— 15 KVA, G.E., 2300-115/230 volts.
2—100 KVA, G.E., 2400/240/480.

GASOLINE DRIVEN D.C. GENERATOR SETS

2—25 KW, 125 volt.
1—30 KW, 125 volt.

It's Hemphill for Power!

J. L. HEMPHILL & CO.

Electrical Engineering and Equipment

OFFICE AND WAREHOUSE:
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NORTH BERGEN, N.J.

PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

REMEMBER "U.E.M." FOR THE FINEST IN POWER PLANT MACHINERY

Units listed available for immediate delivery

TWO COMPLETE POWER PLANT INSTALLATIONS

1 1000 KW 80% P.F.—1250 KVA, 3 phase, 60 cycle, 240 volt, 3600 RPM Elliott alternating current generator direct connected to a 1000 KW, 3600 RPM, 175 to 300 lbs. pressure straight condensing having bleeder opening for 7600 lbs. steam per hour and 10 lbs. extraction pressure, complete with exciter, switchboard panel and instruments, Elliott jet condenser, pumps, piping, valves and fittings. Installed new 1939, equivalent to new.

2 324 HP Babcock & Wilcox-Sterling water tube boilers, National code, 175 lbs. pressure complete with Taylor stokers and all auxiliaries. Excellent condition; new 1922.

1 500 KVA or 400 KW 80% P.F. Westinghouse, 3 phase, 60 cycle, 460 volts, 164 RPM alternating current generator direct connected to a 26"x28" Skinner horizontal Universal Unaflow, side-crank, bored-guide, left-hand poppet valve, heavy duty, full floating piston, non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back pressure, complete with exciter, switchboard panel and instrument.

3 407 HP Wickes horizontal cross drum box header type water tube boilers built under ASME and National codes, 160 lbs. pressure, each complete with stoker and all auxiliaries. Two of these boilers are set in one battery and the third in a single battery. This plant is modern in type and constructon, and in first-class operative condition.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3125 KVA G.E. 180-200 lbs. pressure, 500° TT, 2300 volts, 3600 RPM, equipped with surface condenser, condensing auxiliaries, exciter unit, switchboard with instruments (a complete installation).

1875 KVA G.E. condensing 175-200 lbs. pressure, 500° TT 6600 volts, 3600 RPM complete with condenser.

937 KVA G.E. condensing 150-175 lbs. pressure, 2300 volts, 3600 RPM with direct shaft exciter, surface condenser and auxiliaries.

780 KVA Westinghouse non-condensing 175-200 lb. pressure, 15 lb. back pressure, 480 volts, 3600 RPM, complete with switchboard.

625 KVA Westinghouse non-condensing, 150-200 lbs. pressure, 35 lbs. gauge back pressure, 2300/480/240 volts complete with switchboard.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

125 KVA Westinghouse non-condensing, 175-200 lbs. pressure, 0-10 lbs. gauge back, 240 volts with direct connected exciter and switchboard.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle

Alternating Current

375 KVA Westinghouse 240 volts, 225 RPM generator direct connected to 440 HP, 4 cylinders Nordberg vertical Diesel engine.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17"x24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

200 KVA General Electric 240 volts, 200 RPM generator direct connected to Skinner Unaflow engine—complete.

SPECIAL OFFERINGS

1690 C.F.M. 110 lb. air pressure Ingersoll-Rand steam driven air compressor 125 to 150 lbs. steam pressure.

1590 C.F.M. 100 lb. air pressure Hardie-Tynes steam driven air compressor 150 to 175 lbs. steam pressure.

500 KVA G. E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

600 HP 90% P.F. 3 phase, 60 cycle, 2300 volt, 180 RPM Allis-Chalmers synchronous motor.

ENGINE-GENERATOR UNITS

Direct Current

350 KW G.E. 250 volt, 175 RPM generator, direct connected to a 28"x28" Skinner Universal Unaflow non-condensing engine.

125 KW 125 volt, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lb. pressure, 10 lb. back pressure, complete with switchboard.

75 KW 125 volt, 1800 RPM Westinghouse non-condensing turbine-generator unit.

75 KW 125 volt, 2400 RPM Allis Chalmers Terry non-condensing turbine-generator unit.

15 KW (3) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to an American Blower vertical engine.

FREQUENCY CHANGER SETS

750 KVA Westinghouse, 3-phase, 60 cycle, 2300 volts alternating current generator direct connected to 910 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

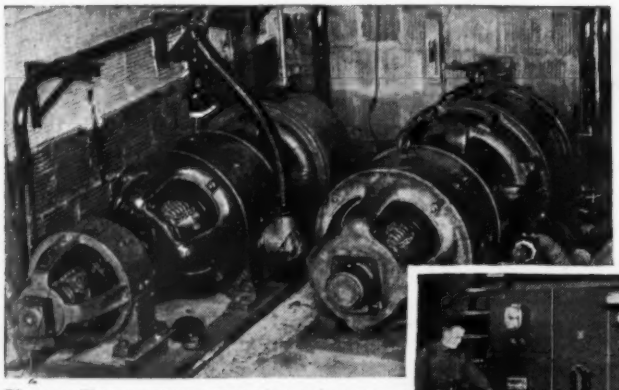
1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connecting to 1700 HP, 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

Utilities Electrical Machinery Corporation

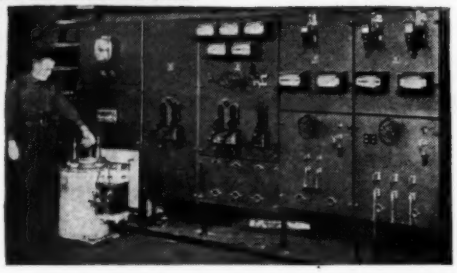
600 NATIONAL CITY BANK BLDG
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

Showing How Belyea "RE-NU-BILT" Equipment is TESTED- -before Shipment!



Above: These motor-generator sets are used in conjunction with a 300 K.V.A. 4600 volt, 3 phase transformer. This supplies all standard A.C. voltages from 110 to 4600 volts, 3 and 2 phase; frequencies from 25 to 60 cycles. Also D.C. voltages from 0 to 550. Both standard and special tests prove the condition of Belyea Equipment before shipment.



At left — Switchboards for test sets consisting of semi-dead front A.C. gen; D.C. gen; and exciter panels. In front of switchboard is G.E. High Potential Transformer for standard A.I.E.E. dielectric tests on insulation, circuit breaker and transformer oil. Adjustable Voltage — range 0/30,000 V. You KNOW it's reliable when it's Belyea "Re-Nu-Bilt" and Belyea TESTED.

Part list of Belyea Equipment—Successful Operation Guaranteed

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1500 KW G.E., 250/275 V. D.C. to 2100 H.P., 2300 V.
1—1000 KW G.E., 250/275 V. D.C. to 1400 HP., 2300/4150 V.
1—1000 KW Whse., 600 V. D.C. to 2000 KVA, 2200 volt with exciter.
1—750 KW G.E. 250 v. D.C. to 1100 H.P. 2300/4150 v.
1—750 KW Whse., 275 V. D.C. to 1100 H.P., 220 volt with exciter.
1—500 KVA—300 KW—220/440 V. A.C. Gen. to 500 H.P.—230 V. D.C. Motor.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.
1—400 KW G.E., 250/275 V. D. C. to 650 H.P. 2300 V.
1—200 KW G.E., 125 V. D.C. to 300 KVA, 440 V. Syn. Motor with exciter.
1—150 KW—Ideal 3 unit consisting of 2—75 KW—125 V. gens. D.C. to 250 H.P., 440 V. Syn.
1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.
1—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

3 Phase 25 Cycle

1—25 KW G.E., 125 V. D.C. to 35 H.P., 360 V. Motor.
1—75 KW Whse., 125 V. D.C. to 110 H.P., 440 V. Motor.
1—250 KW G.E., 250 V. D.C. to 285 KVA. 6600 V. Motor.

TURBO GENERATOR SETS

1—500 KW Whse. 625 KVA, 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.
1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lbs. pressure with 12 lb. bk. pres., 2000 RPM.

FREQUENCY CHANGER

1—1000 KW G.E. with 1250 Kva, .8 p.f. AQB 2300 volt 2 phase (can be changed—800 KW 3 phase) 58.3 cycle gen. and 1400 HP .8 p.f. 440/2200 volt ATI 3 phase 25 cycle motor and exciter.

A.C. MOTORS

3 Phase 60 Cycle

SLIP RING

Qu.	HP	Make	Volts	RPM	Desc.
2	100	G.E.	2200	575	IM
1	100	G.E.	550	685	MTC-5552
1	100	G.E.	550	720	IM
1	100	G.E.	220	1750	IM
2	150	G.E.	4000	585	IM-16
2	250	Whse.	440/2300	450	CW
1	250	G.E.	4000	257	MT-424Y
1	350	G.E.	4000/2200	253	MT-442Y
1	350	G.E.	550	490	MT-412Y
1	400	G.E.	2200	252	IP
1	400	A.-C.	2300	505	ANY
1	450	Whse.	2200	875	CW
1	500	Al. Ch.	2200	590	ANY-36
1	600	Cr. Wh.	2200	507	131-AQ
1	600	G.E.	550	220	MT
1	800	A.-C.	440	885	ANY
1	1200	C. W.	2300	237	801Q

SQUIRREL CAGE

Qu.	HP	Make	Volts	RPM	Desc.
1	100	Whse.	2200	880	CS
1	150	Whse.	550	400	CS-594A
2	175/112	G.E.	440	900/720	IK
1	200	G.E.	2200	490	IK
1	200	G.E.	550	580	IK
1	300	G.E.	440	900	IK
1	300	Whse.	550	580	CS

SYNCHRONOUS

Qu.	HP	Make	Volts	RPM	Desc.
1	75	G.E.	220	600	TS 7556
1	600	Al. Ch.	2300	720	
2	2100	G.E.	2200/4400	514	ATI

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed	Desc.
1	750	G.E.	220/440	900	ATI
1	1000	G.E.	2300/4100	900	ATI
1	2000	Whse.	2300	720	
2	2100	G.E.	2300/4600	514	ATI
1	3000	Al. Ch.	2300	900	
1	5000	Whse.	2300/4000	900	

3 Phase 25 cycle

1	75	Al. Ch.	440	750	ANY
1	150	G.E.	440	500	IM
1	200	G.E.	440	242	Sl. Rg.
1	300	G.E.	440	290	Sl. Rg.
1	390	G.E.	6600	750	ATI
1	1400	G.E.	2300	500	ATI

ROTARY CONVERTERS

3 Phase 60 Cycle

Qu.	KW	Make	Speed	Dc V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	Whse.	720	250	22000
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
2	300	G.E.	1200	600	2300
1	300	Al. Ch.	1200	250	2400

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500/225/275/13200/6600
1	500	G.E.	750/225/275/13200/6600

All units can be furnished with AC and DC controls

D.C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	180
1	1200	Whse.	Int.	600	600/720
1	1200	G.E.	MPC	600	450
1	800	G.E.	MPC	550	600
1	700	G.E.	MPC	250	220/440
2	625	G.E.	MPC	500	130
1	500	Whse.	Int.	250	250/720
1	500	G.E.	MPC	230	900
1	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	Al. Ch.		230	525
1	250	G.E.	C	230	375
2	200	Whse.	SK	230	400
1	175	Whse.	SK	230	150/525
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625
1	100/150	Whse.	SK-200	550	600
1	100	G.E.	LC-50	230	1200
1	100	Whse.	SK-180	230	600
1	100	G.E.	RC-38	230	600
1	75/100	Whse.	SK-183	230	450/900
1	50/100	G.E.	MPC	230	225/450
2	75	Whse.	SK-183	230	500/1000
1	75	G.E.	C	230	500/1000
1	60	El. Dy.	255	230	525/1050
1	50/60	Cr. Wh.	CMC-65H	230	500/1000
1	50	G.E.	RC-19	230	400/1200
1	50	Cr. Wh.	CMC-80H	230	880/750
1	15/50	Cr. Wh.	CMC-81H	230	300/900

SUCCESSFUL OPERATION GUARANTEED
Quality without Question

BELYEA CO., INC.
Main Office and Shop
43 HOWELL ST., JERSEY CITY, N.J.

RE-NU-BILT BELYEA MOTORS

Below BERGER OFFERS

Rebuilt and Sold with a Standard New Guarantee

ONLY PARTIAL LIST

TRANSFORMERS

1—200 KVA GE, type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—200 KVA GE, type H Form VD 4800/2400/480 volts, 1 PH. 25 cy.
1—100 KVA GE, type H Form KDD 11000/2600 volt, 1 PH, 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
3—75 KVA Gen. Elect. K.S. 1 ph. 60 cy. 2300/115/230 volts.

OTHER SIZES VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle, 3 phase, 450 R.P.M. with direct connected exciter.
200 KW, Westh. Unity Power Factor, 3 PH, 60 cyc. 220/440 900 R.P.M. with direct connected exciter.
150 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts, 600 R.P.M. Revolving field with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 with Rev. Field. and built in Exc.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.

FREQUENCY CHANGERS

30 KVA, Gen. Elect. type I.T.T. frame 526 P.F. 08—220/440 volts 3 Ph. 60 cy. to 240 volts 120 cycle Motor KT frame 526—3 Ph, 60 cy. 220/440 volts 1800 RPM.

ALL SIZES VOLTAGES AND CYCLES

3 ph. 25 cy. Motors

H.P.	Make	Type	Speed	Volt
350	Gen. Elec. Sl. Rg. 3 Brg	I	375	400
200	Lincoln S. R.	I. X. W.	500	440
100	Wagner Sl. Rg.	BR	750	220/440
Stator and Rotor Only—For Compressor-Service				
100	West. Syn.	H.R.	300	2200
Stator and Rotor Only—For Compressor-Service				
70	Gen. Elec. Syn.	ATI	167	2200

3 ph. 60 cy. A. C. Motors

H.P.	Make	Type	Speed	Volts
200	West. Syn.-Dir. Con. Ex.	P. F. 08	900	220/440
200	Gen. Elec. Syn.	ATI	514	4000/2300
200	Weghse. Syn.	Dir. Con. Exc.	600	2300
Stator and Rotor Only—For Compressor-Service				
150	Gen. Elec. Syn.	ATI	400	2200
25	Gen. Elec. Sq.	I. K. Vert.	720	220

230 Volt D. C. Motors

H.P.	Make		Speed
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	700
60	Sprague	D — Comp. Wound	625
40	Fair. Morse	Ball BRG. Vert. Comp.	1740

125 Volt D. C. Motors

H.P.	Make	Type	Speed
60	Allis Chalmers	FB131-Comp.	1755

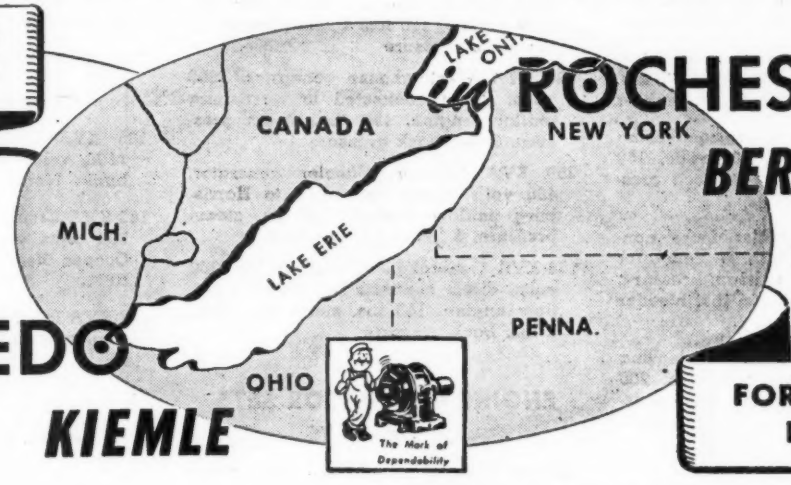
550 Volt D. C. Motors

H.P.	Make	Type	Speed
35	West.	SK 150 Shunt Int.	850

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire. 115/230 V. 600 R.P.M.
50 KW—Northern—Comp. 110 V.—700 R.P.M.

OVER 10,000 STOCK ITEMS



THE FRED W. KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO 4 OHIO

BERGER BROTHERS ELECTRIC MOTORS, Inc.
395 STATE ST.
ROCHESTER 4
NEW YORK

FOR IMMEDIATE DELIVERY

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300 1 phase 25 cycle.
1—350 KVA, GE, type H-K.D.D. 2300/460—1 PH, 60 Cy.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
3—75 KVA Pitts. 1 Ph. 60 cy. 2300/230/115 volts.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

10 K.W. Gen. Elect. 1 Ph. 60 Cy. 220 Volts—1800 R.P.M.

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed with transformers for 2300 volts to 230 volts D.C.

WEST. D.C.—VARIABLE SPEED MOTORS

10—10 H.P. Type S.K. 230 V. 500/1500 R.P.M. with Automatic Dynamic Braking Starters and Field Rheos.

3 ph. 60 cy. A. C. Motors

H.P.	Make	Type	Speed	Volts
Stator and Rotor Only—For Compressor-Service				
500	El. Machinery Syn.		257	440
200	Weghse. Sl. Rg.	CW	600	220/440
150	Gen. Elec. S. R.	I. M.	450	440
150	Gen. Elec. Sq. Cg.	I.K.	600	2300
100	Gen. Elec. S. C.	K.T.	720	440
100	Lincoln	M	1150	440
100	Gen. Elec. R	MT	600	440

3 ph. 25 cy. Motors

H.P.	Make	Type	Speed	Volts
150	Gen. Elec. S. R.	IM	500	440
100	Allis Ch. S. R.		750	440
75	Gen. Elec. Var.	BTA	375/750	440
75	Gen. Elec. S. R.	I. M. 17B	160	440
75	Gen. Elec. Sl. Rg.	I. M.	750	220/440

230 Volt D. C. Motors

H.P.	Make	Type	Speed
150	West.	SK 180L Comp. Wd. Int.	1150
100	Northwestern	K30 Comp. Inter.	1750
75	West.	SK 150 Shunt	1200
50	Crocker Wheeler	CM	625

MOTOR GENERATOR SETS

Gen.-Elect—100 KW. 2 brg. 125 volts D.C. Comp WD-Int. with 220/440 volts Sq. Cg. Motor.

Rebuilt and Sold with a Standard New Guarantee

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

Above KIEMLE OFFERS

POWER PLANT MACHINERY

TURBINE GENERATOR UNITS

3 phase, 60 cycle

3750 KVA General Electric condensing turbine generator unit, 2300 volts, 175 lbs. steam pressure, with surface condenser

2500 KVA General Electric condensing turbine generator unit, 2300 volts, 150 lbs. steam pressure, with surface condenser

1563 KVA General Electric condensing turbine generator unit, 2300 volts, 160 lbs. steam pressure, with jet condenser

937 KVA General Electric condensing turbine generator unit, 2300 volts, 150 lbs. steam pressure, with surface condenser

750 KVA General Electric condensing turbine generator unit, 2300 volts, 150 lbs. steam pressure, with jet condenser

625 KVA General Electric condensing turbine generator unit, 2300 volts, 170 lbs. steam pressure, with surface condenser

375 KVA General Electric non-condensing turbine generator unit, 600 volts, 150 lbs. steam pressure, 7 lbs. back pressure

312 KVA Crocker Wheeler-Moore non-condensing bleeder turbine generator unit, 240 volts, 425 lbs. steam pressure, 18 lbs. back pressure, 125 lbs. bleeder pressure

250 KVA Allis Chalmers non-condensing turbine generator unit, 440 volts, 200 lbs. steam pressure, 25 lbs. back pressure

ENGINE GENERATOR SETS

125 volts D. C.

200 KW Crocker Wheeler generator direct connected to Skinner uniflow engine, 125 lbs. steam pressure, 5 lbs. back pressure.

100 KW Crocker Wheeler generator direct connected to Ames uniflow engine, 125 lbs. steam pressure, 5 lbs. back pressure

75 KW Crocker Wheeler generator direct connected to Ames uniflow engine, 125 lbs. steam pressure, 5 lbs. back pressure

ENGINE GENERATOR SETS

3 phase, 60 cycle

750 KVA General Electric generator, 2300 volts direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

675 KVA General Electric generator, 480 volts, direct connected to Ames uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

625 KVA General Electric generator, 2300 volts, direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

450 KVA General Electric generator, 240 volts, direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

375 KVA Westinghouse generator, 2300 volts, direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

300 KVA Westinghouse generator, 2300 volts, direct connected to Harrisburg uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

250 KVA Crocker Wheeler generator, 480 volts, direct connected to Harrisburg uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

156 KVA General Electric generator 2300 volts, direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

ENGINE GENERATOR SETS

250 volts D. C.

300 KW General Electric generator direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

250 KW Crocker Wheeler generator direct connected to Skinner uniflow engine, 125 lbs. steam pressure, 5 lbs. back pressure

200 KW General Electric generator direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

200 KW Crocker Wheeler generator direct connected to Ames vertical uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

135 KW Westinghouse generator direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

DIESEL GENERATOR UNITS

3 phase, 60 cycle

500 KVA Fairbanks Morse generator, 2400 volts, direct connected to Fairbanks Morse Diesel engine, 257 RPM.

312 KVA Westinghouse generator, 240 volts, direct connected to McIntosh-Seymour Diesel engine, 360 RPM.

300 KVA Fairbanks Morse generator, 2400 volts, direct connected to Fairbanks Morse Diesel engine, 300 RPM.

282 KVA General Electric generator, 240 volts, direct connected to Winton Diesel engine, 400 RPM.

219 KVA Fairbanks Morse generator, 2400 volts, direct connected to Fairbanks Morse Diesel engine, 300 RPM.

185 KVA Fairbanks Morse generator, 2400 volts, direct connected to Fairbanks Morse Diesel engine, 300 RPM.

143 KVA Crocker Wheeler generator, 120-208 volts 4-wire, direct connected to Cooper Bessemer Diesel engine, 514 RPM.

118 KVA Ideal generator, 248 volts, direct connected to Winton Diesel engine, 400 RPM.

94 KVA Fairbanks Morse generator, 240 volts, direct connected to Fairbanks Morse Diesel engine, 360 RPM.

ENGINE GENERATOR UNITS

125/250 volts 3-wire D. C.

200 KW Crocker Wheeler generator direct connected to Ames uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

150 KW Burke generator direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

100 KW General Electric generator direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

DEPENDABLE ELECTRICAL EQUIPMENT

LAND

Guarantee * * * The equipment will be furnished completely and thoroughly shop reconditioned, tested and guaranteed mechanically and electrically free from inherent defects; and if operated under normal conditions, with proper care and competent supervision, we will f.o.b. our plant, New York, N. Y., correct by repair or replacement at our option, defects occurring in this equipment within one year from date of shipment.

1 YEAR!

SQUIRREL CAGE MOTORS
3 ph. 60 Cy.

Qu.	HP	Make	Type	Speed
1	200	G.E. 440 v.	IK	600
1	147	West. 25 cy.	CS	715
1	100	Al. Ch.		690
2	100	G.E. 440 v.	PTA564	375/750
1	85	G.E. 2300 v.	PT529	3600
1	75	El. Dy.	KNX505	1750
1	75	Burke		1150
1	50	G.E.	KT537	1750
1	50	Star	A75	1750
1	50	West.	CCL	1150
1	50	Al. Ch.		865
1	50	Cr. Wh.		865
1	50	Burke		690
1	50	West.	CS	580
2	45	W.E.		150/900
1	40	West.	CS	1760
4	40	El. Dy.	DNX444	1760
1	40	G.E.	KT	1150
1	40	Lincoln		1150
1	35	Wagner		850
1	35	West.	CS	690
1	30	U. S. Vert.	CPU907	3450
1	30	A-C		1150
1	30	Diehl		860
1	30	Cr. Wh.		870
1	30	Al. Ch.		870
1	30	G.E.	KT342	690
1	30	West.	CCL	690
1	30	G.E.	IK	514
1	25	Triumph		1750
1	25	G.E.	KT302	1750
1	25	Wagner 220v.	F-W	12200
1	25	Al. Ch.		1150
1	25	West.	CS	1150
1	25	El. Dy.	KMQ444	865
2	25	G.E.	IK	865
2	25	Diehl	18167	865
1	25	West.	MS	860
1	25	Wagner 440v.	P-W	720
1	25/12½	G.E.	445	840/405
1	20	West.	CS365	3500
1	20	G.E.	PT312	1740
1	20	G.E. Vert.	PT501	1750
9	20	El. Dy.	KNX364	1750
1	20	F.M.	KMV12D	1150
2	20	G.E. Vert.	KT512	1150
1	20	Cr. Wh.		1150
1	20	F.&M.		1160
2	20	West.	CS	1160
1	20	G.E.	KT332	1160
2	20	Al. Ch.		860
1	20	F.M.		860
1	20	Diehl		860
1	20	West.	CS566	870
1	20	G.E.	KT326	870
1	20	G.E.	IK	690
1	20	West.	CS584	690
1	20	West.	CCL	690
1	15	West.	CS324	3500
9	15	G.E.	KF751	3400
1	15	Burke		1750
1	15	Wagner 220v.	P-W	1800
21	15	El. Dy.	326	1750
1	15	Lincoln		1150
1	15	G.E. Vert.	KT502	1150
1	15	West.	CCL	1150
3	15	West.	MS	1150
1	15	West.	CS	1150
1	15	G.E. Vert.	IK	860
1	15	West.	CS	860
1	15	Wagner 440v.	F-W	720
1	15	G.E.	IK	720
8	10	G.E.	KT	3600
12	15	West.	CS 445	600/900 1200/1800

SQUIRREL CAGE MOTORS
2 ph. 60 cy. type

Qu.	HP	Make	Type	Speed
1	75	G.E.	IQ	1750
1	70	G.E. Synch.	AQI	1200
1	50	Lincoln		870
1	50	G.E.	IQ	870
1	40	Al. Ch..		870
1	40	F-M		870
1	35	Al. Ch.		870
1	30	West.	CCL	1150
1	25	G.E.	KQ312	1750
3	25	G.E.	ICL	1150
1	25	West.	CCL	1150
1	25	Burke		900
1	20	West.	CS	1160
1	15	F-M		1750
1	15	G.E.	KQ502	1150
1	15	West.	CS4	1150
1	15	G.E.	IQ	720

SLIP RING MOTORS
2 & 3 ph. 60 cy.

Qu.	HP	Make	Type	Speed
1	450	G.E.	MT412	506
1	250	G.E.	IM	580
1	150	El. Dy.	New	1770
1	100	G.E.	MTC5546	800
1	100	G.E.	IM	900
1	100	G.E.	IM	690
1	100	F-M	FA	690
1	75	G.E.	IM	1160
1	75	West.	RF	1160
1	75	Al. Ch.		865
1	75	Al. Ch.	ANY	575
1	65	G.E.	MTC552	585
2	60	Otis		1750
1	60	West.	CW648	1150
1	60	West.	CW950A	290
1	50	G.E.	Ig	870
1	50	Wagner		1150
1	40	F-M		870
1	40	West.	CW	870
1	35	Burke		690
1	40	G.E.	MT312	570
1	30	G.E.	MC332	870
2	30	G.E. 220 v.	MT542	690
1	25	West.	CW	1160
2	25	Al. Ch.	ANY20G	870
1	25	Burke	FMV3	870
1	25	Howell	SFS420	870
1	25	West.	CW748	575
2	15	G.E.	MT502	1150
1	15	West.	CW	870
1	15	Cleveland	MW147	870

A. C. GENERATORS

Qu.	KW	Make	Voltage	Speed
1	150	G.E.	220/440	600
1	150	Cr. Wh.	220/440	900
1	100	West.	220/440	600
1	35	Allen	220/440	900
1	35	Burke	220/440	720
1	50	Elec. Mchy.	220/440	900
1	25	West. 1 ph.	110/220	1200

PLATER

7500 Amp. Electric Products 6/12 volt, 400 RPM. with 100 H.P. Gen. Elec. TS Syn. Motor with automatic starter.

230 V. D.C. MOTORS

Qu.	HP	Make	Type	Speed
1	350	West.	SK	340/425
1	150	West.	S	600
1	60	G.E.	LC	450/1160
1	60	El. Dy.	258	450/900
1	50	El. Dy.		900
1	50	West.	SK150	550/1100
1	45	Diehl		850
1	40	G.E.	DLC	1050
40	40	Cr. Wh.	CCM	915
1	35	West.	SK	1150
1	35	West.	SK120	975
1	35	G.E.	PLC204	440/880
2	35	West.	SK160	400/600
2	30	G.E.	CD83	3450
1	30	G.E.	RC	1150
1	30	West.	SA	975
1	25	G.E.	RC	1150
1	25	West.	SK	1150
1	25	Diehl	K8	850
1	25	Al. Ch.		850
1	25	El. Dy.		1500
1	25	G.E.	CD113	575
1	20	G.E.	CD83	1200/1600
1	20	R. & M.		1150
1	20	G.E.	RC	1150
1	20	El. Dy.		950
1	20	G.E.	RC	800
1	20	West.	SK110L	750
1	15	Roch.	SV5	3450
3	15	G.E.	RC	1150
2	15	G.E.	CD	1150
1	15	G.E. Vert.	CD	900
1	15	West.	SK	850
1	15	G.E.	RC	850
1	15	West.	SK	600/2500
1	13	Diehl		200/247
1	10	G.E.	RF	450/1800
1	10	G.E.	CD	1150
1	10	West.	SK	400/1200
3	10	G.E.	RC	850
1	10	G.E.	CVC	700
1	10	Diehl		750
1	10	West.	SK	600/1200
1	10	El. Dy.		450/1800
1	10	G.E.	RF	400/1600
2	10	West.	SA	400/1200
1	10	G.E.	RF	450/1800
1	8½	Diehl		900
1	8½	West.	SK	850
1	8½	West.	SK90	350/1400
1	8	G.E.	RLC	500/1500
1	7½	G.E.	RC	1700
1	7½	G.E.	CVC	1525
1	7½	West.	SK	1450
3	7½	G.E.	RC	1150
2	7½	G.E.	RC	1150
1	7½	West.	SK	950
1	7½	Al. Ch.		850
1	7½	G.E.	RC	850
3	7½	G.E.	RF	600/1800
1	7½	El. Dy.		550/1650
1	7½	Watson		525/1150
2	7½	G.E.	RF	450/1800
1	7½	West.	SK	450/1600
1	7½	Al. Ch.		350/1050

110 V. D.C. Motors

Qu.	HP	Make	Type	Speed
1	90	G.E.	DLC65	900
1	30	G.E.	CD	1150
1	15	EK		1000
1	15	El. Dy.		615/1230
1	10	El. Dy.	38	1100
1	10	West.	SK	850
1	10	El. Dy.	7½8	425/1275
1	10	Diehl		230
1	7½	Cr. Wh.		900
1	7½	West.	SK	500
1	7½	El. Dy.	58	450/900
2	7½	El. Dy.	58	600/1200

D.C. GENERATORS

KW	Make	Volts	Amps	Speed
300	West.	250	1200	900
250	G.E.	125	2200	720
100	West.	250	400	720
100	Al. Ch.	250	400	570
100	G.E.	125	800	1150
50	G.E.	250	200	870
50	G.E.	125	400	1150
45	El. Pro.	6/12	7500/3750	400
40	El. Dy.	250	160	1150
30	Reliance	250	120	1750
30	West.	125	240	1160
30	El Dy.	600	50	1150
30	Har.	60	500	1150
25	West.	125	200	1150
25	El. Mchy. Sny.	125	200	1200
25	G.E.	250	100	1150
20	G.E.	125	160	1150
20	West.	250	80	1150
15	Burke	125	120	900
15	G.E.	250	60	1150
10	Al. Ch.	125	80	1150
10	G.E.	250	40	1150
7½	West.	250	30	1150
7½	G.E.	125	60	1150
5	G.E.	250	20	1150
5	West.	125	40	1150
5	G.E.	600	9	1750

15—100/125 Amp. 7½ Volt D.C. Generator 3 ph. 60 cy 220/440 Volt Motors.

SPECIAL
Paper Mill Drive and Power Plant

625 KVA Westinghouse Geared Turbine, 150 lbs., 35 lbs. back pressure 3 ph. 60 cy. 2400 Volt .8PF also driving 300 KW West. SK 250 Volt D.C. Generator 900 RPM. with 350 HP. West. SK 250 V. D.C. Motor, double end shaft, speed 0 to 600 RPM. Complete with all control and necessary Motor Generator exciters. Sell complete or any part

COOLANT PUMPS

50—New Ruthman (Gusher) Coolant pumps, with ¼ H.P. 3 ph 60 cy. 220/440 Volt Motors.

400 Cycle Generators

3—1 KVA Holzer Cabot 3 ph. 60 cy. 2201 440 V.

ROTARY CONVERTERS

4—5 KVA Crocker Wheeler.
15—.225 KVA Kato 32 V. D.C. to 110/60/1 ph.

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THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.
1—18750 KVA General Electric Cond.
2—15500 KVA Westinghouse Cond.
1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 3125 KVA General Electric Extrac.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Allis Chalmers Cond.
1— 1563 KVA Westinghouse Extrac.
1— 750 KVA General Electric Cond.
1— 625 KVA General Electric Cond.
1— 625 KVA General Electric Non-C.
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

D. C. TURBO UNITS
1—1500 KW General Electric 250 V.
2—1000 KW General Electric 250 V.
1— 125 KW General Electric 125 V.
1— 75 KW General Electric 125 V.
1— 25 KW Westinghouse 125 V.

STEAM ENGINE UNITS—60 Cy.
1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 375 KVA Skinner Uniflow
1— 375 KVA Harrisburg Uniflow
1— 350 KVA Ames Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 210 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow
1— 94 KVA Ridgway 4-valve
1— 93.8 KVA Skinner Uniflow

D. C. STEAM ENGINE UNITS
1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—150 KW Ridgway 4-valve 125/250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

OIL & GAS ENGINE UNITS
1—625 HP Worthington, 240 V. 60 cy. gen.
1—610 HP Campbell, 2400 V. 60 cy. gen.
1—520 HP Busch Sulzer, 2400 V. 60 cy. gen.
1—450 HP M.A.N., 2300 V. 60 cy. gen.
1—440 HP Nordberg, 250 V. DC gen.
1—375 HP Worthington, 240 V. 60 cy. gen.
1—300 HP Worthington, 2300 V. 60 cy. gen.
1—300 HP McInt. & Say., 480 V. 60 cy. gen.
1—283 HP Coop.-Bess., 230 V. 60 cy. gen.
1—175 HP Sterling (gas), 480 V. 60 cy. gen.
3—160 HP Coop.-Bess., 216 V. 60 cy. gen.
1—145 HP Superior, 220 V. 60 cy. gen.
2—125 HP Winton, 240 V. 60 cy. gen.

SURFACE CONDENSERS
1—20,000 sq. ft. Worthington
1—12,000 sq. ft. Worthington
1— 5,000 sq. ft. Westinghouse
1— 4,100 sq. ft. Ross

WATER TUBE BOILERS
1—880 HP B. & W. 250-lb., Stoker
2—680 HP Springfield 200-lb., Stokers
1—612 HP Stirling 200-lb
2—560 HP Erie City 460-lb.
2—512 HP Stirling 205-lb.
2—502 HP Wickes 160-lb., Stokers
1—484 HP Springfield 200-lb., Oil Fired
1—481 HP Springfield 225-lb., Pulverizer
2—407 HP Wickes 160-lb., Stokers
2—405 HP Erie City 160 lb., Stokers
1—404 HP Springfield 170-lb.
2—312 HP Stirling 160-lb., Stokers
2—300 HP Heine 200-lb.
2—300 HP B. & W. 160-lb.
2—220 HP B. & W. 200-lb., Oil Fired

AIR COMPRESSORS
1—3093 Ft. 105-lb. Worthington, 60 cy. motor
1—2500 Ft. 100-lb. Chicago Pneu., 60 cy. motor
1—2200 Ft. 100-lb. Ing. XPV, steam driven
1—1570 Ft. 100-lb. Worthington, 60 cy. motor
1—1300 Ft. 100-lb. Ing. XPV, steam driven
1—1051 Ft. Sullivan, 60 cy. motor
1— 610 Ft. 100-lb. Ing. XCB, V belt drive
1— 380 Ft. Ing. XRE, 60 cy. motor

SYNCHRONOUS MOTORS
2—1250 HP G. E. 25 cy. 2200 V. 750 RPM
2—1125 HP G. E. 60 cy. 480 V. 720 RPM
1— 200 HP Ideal 60 cy. 4000 V. 514 RPM
1— 175 HP West. 60 cy. 4000 V. 514 RPM
1— 150 HP West. 60 cy. 2200 V. 600 RPM
1— 125 HP G. E. 60 cy. 220 V. 720 RPM
1— 100 HP G. E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.
4—3500 HP G. E. slip ring 2300 V. 120 RPM
1—2500 HP G. E. slip ring 6600 V. 253 RPM
1—1500 HP G. E. slip ring 6600 V. 253 RPM
1—1000 HP G. E. sq. cage 2300 V. 509 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
1— 500 HP G. E. slip ring 440 V. 450 RPM
2— 400 HP G. E. slip ring 3800 V. 1800 RPM
1— 300 HP G. E. sq. cage 440 V. 1800 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
3— 250 HP West. slip ring 2300 V. 720 RPM
1— 150 HP G. E. slip ring 440 V. 450 RPM
1— 100 HP G. E. sq. cage 2200 V. 900 RPM
1— 75 HP G. E. sq. cage 440-V. 514 RPM

MOTOR GEN. SETS—60 Cy.
1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 500 KW Elec. Machy. 250 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 200 KW Westinghouse 250 V. DC
1— 150 KW Westinghouse 250 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.
2—2600 KW General Electric 250 V.
2—2500 KW Westinghouse 250 V.
2—1700 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

FREQUENCY CHANGERS
2—12500 KW G. E. 60/25 cy. 300 RPM
2— 5000 KVA West. 25/60 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 2500 KVA West. 25/60 cy. 300 RPM
1— 1875 KVA G. E. 25/60 cy. 300 RPM
2— 1250 KVA G. E. 25/62½ cy. 750 RPM
1— 1250 KVA G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 60/25 cy. 300 RPM

SYN. CONDENSERS—60 Cy.
1—5000 KVA West. 5000 V. 720 RPM
1—3000 KVA Al. Ch. 2200 V. 900-RPM
1—2000 KVA Elec. Mcy. 460 V. 900 RPM
2—1250 KVA G. E. 480 V. 720 RPM

TRANSFORMERS—1 Ph., 60 Cy.
2—10000 KVA West. 115,000-6900 V. 3 ph.
4— 500 KVA West. 110,000-2300 V.
3— 4000 KVA West. 63.5/110-19/33 KV
4— 2500 KVA G. E. 63.5/110-19/33 KV
3— 2500 KVA Pitts. 66000-25400/12700 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA Pitts. 66000-33000 V.
3— 600 KVA West. 66000-2300 V.
3— 333 KVA G. E. 66000-480 V.
3— 100 KVA G. E. 66000-6900/11000 V.
3—1667 KVA G. E. 44000-2300/4000 Y V.
4—1667 KVA Pitts. 33000-2400 V.
3— 833 KVA Al. Ch. 34460-4800/2400 V.
3— 200 KVA G. E. 33000-2300/4000 Y V.
3— 150 KVA G. E. 33000-2300 V.
3— 75 KVA G. E. 33000-13200/11000 V.
1—15000 KVA A Ch. 27880-4560 V. 3 ph.
2—10000 KVA West. 26400-4560 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
3— 667 KVA Packard 23000-440-V.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 200 KVA G. E. 22000-230/460 V.
1—10000 KVA West. 13200-4560 V. 3 ph.
1— 3000 KVA Kuhlman 13800-480 V. 3 ph.
3—1667 KVA Pitts. 13200-2300 V.
3— 200 KVA G. E. 13200-480 V. Pyranol
7— 667 KVA Moloney 11000-2300 V.
3—1250 KVA G. E. 6600-550 V.
3— 100 KVA G. E. 6900-230/460 V.
3— 75 KVA G. E. 6900-230/460 V.
6— 25 KVA West. 6900-230/460 V.
3— 150 KVA G. E. 2400-120/240 V.

VOLTAGE REGULATORS
60 Cycle Induction
1—72 KVA 300 A. 2400 V. Gen. Elec.
2—46 KVA 200 A. 2300 V. West.
6—36 KVA 150 A. 2400 V. Gen. Elec.
6—24 KVA 100 A. 2400 V. Gen. Elec.

OIL CIRCUIT BREAKERS
1— 400 A. 73 KV G. E. FKO36 Outdoor
1— 400 A. 73 KV G. E. FHKO36 Outdoor
1— 400 A. 50 KV G. E. FKO136 Outdoor
6— 400 A. 37 KV G. E. FHKO136 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
1— 400 A. 25 KV G. E. FKO136 Outdoor
2— 600 A. 15 KV G. E. FKO37 Outdoor
1— 600 A. 15 KV West. O-221 Outdoor
2— 400 A. 15 KV G. E. FHKO136 Outdoor
6—1200 A. 4.5 KV Condit D-12 Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7, New York

Immediate Delivery

10 COMPLETE TURBO-GENERATOR UNITS IN STOCK—OUR OWN PROPERTY

CAPACITIES: 7500, 6125, 3125, 1875-KVA., and Almost Any Type or Capacitly Desired.

DEPENDABLE MACHINES OUR SPECIALTY

Correspondence Invited

WILMS, WEAVER & COMPANY

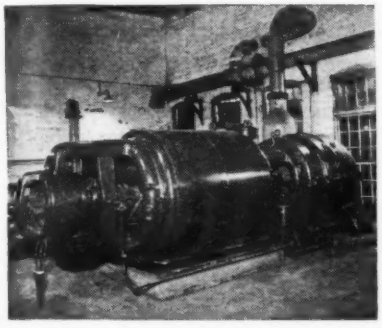
4045 Penobscot Building — **Detroit 26, Michigan**

Extraordinary Liquidation

6 COMPLETE POWER PLANTS

Operated by the Georgia Power Company as recently as Dec., 1944

We are listing herewith excellent high-pressure power equipment which has just been released for sale. All this equipment has been maintained in excellent condition and is ready for immediate operation complete with all accessories. Included are all switchboards, motors, panels, transformers, motor-generator sets, exciters, automatic circuit breakers, compensators, rheostats, oil-switches, control-apparatus, pumps, blowers, heaters, piping and all auxiliary equipment. This machinery will move quickly and we urge that you arrange for immediate inspection at the premises.



GENERAL ELECTRIC 2,000 Kilowatt Turbo Generator. Actual Photo As of January 1945.

ATHENS, GA.

1—500 KW Westinghouse Turbo-Generator, 150# Steam Pressure, 2300 Volts, 3 Phase, 60 Cycle, 3600 R.P.M., with Westinghouse-LeBlanc Jet Condenser.
2—370 HP Sterling Water Tube Boilers.
2—390 HP Sterling Water Tube Boilers.
1—600 HP Babcock & Wilcox Water Tube Boiler.
1—300 KW General Electric Rotary Converter, Type HC, 8-300-900, Form P, 60 Cycles, Continuous Current, 600 Volt, 500 Amps., complete with Panel and Transformers.
1—Pawling & Harnischfeger Overhead Trolley Crane.
1—180' Steel Stack (approximate).

AMERICUS, GA.

2—375 KW Allis-Chalmers Turbo-Generators, 160# Pressure, 3600 R.P.M., 2300 Volts, 94.4 Amps., 3 Phase, 60 Cycle, with Wheeler Surface Condensers.
1—575 KW Allis-Chalmers Turbo-Generator, 160# Pressure, 2300 Volts, 157 Amps., 3 Phase, 60 Cycle, with Wheeler Surface Condenser.
1—Maris Bros. Overhead Crane.
2—200 HP Casey Hedges Water Tube Boilers, F-27-38 Foster Superheaters.
1—380 HP Heine Water Tube Boiler.
1—81' Steel Stack.

AUGUSTA, GA.

1—2750 KW General Electric Turbo-Generator, Steam Pressure, 150#, A.C. Generator, Type AQB, Class 4—Form HT, Speed 1800 R.P.M., 2300 Volts, 598 Amps., W. M. Kellogg Co. Twin Bulkley Injector Condenser.
3—400 HP Casey Hedges W T Boilers.
1—500 HP Casey Hedges Water Tube Boiler. Foster Superheater. These Boilers are Oil-Fired, system complete, Automatic Draft Control equipment, etc.

LANGSDALE, ALA.

1—2000 KW General Electric Turbo-Generator, 180# Pressure, 3600 R.P.M. Generator, Type ATB, 600 Volt A.C., 2403 Amps., with Westinghouse-LeBlanc Jet Condenser.
1—750 KW General Electric Turbo-Generator, 150# Pressure, Type ATB, Form HT, 600 Volts, 3600 R.P.M., with Westinghouse-LeBlanc Jet Condenser.
3—308 HP Heine Water Tube Boilers.
1—518 HP Heine Water Tube Boiler.
1—Overhead Trolley Crane—Maris Bros., 20 Ton.

For Further Details

TELEPHONE, WIRE OR WRITE US AT THIS OFFICE OR THAT OF OUR SOUTHERN ASSOCIATES

ATLANTA STEEL AND SUPPLY COMPANY

349 Decatur Street

Atlanta 3, Georgia

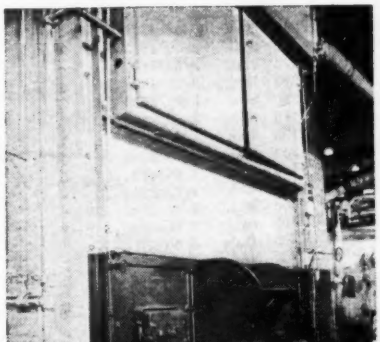
Telephone Walnut 9412 Main 4947

GRIFFIN, GA.

1—2000 KW General Electric Turbo-Generator, 2500 KVA, 6600 Volts, 219 Amps., 3600 R.P.M., Type ATB, Form HT, direct-connected Exciter with Elliott Jet Type Condenser.
1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 R.P.M., direct-connected Exciter, Wheeler Jet Condenser.
2—512 HP Babcock & Wilcox Water Tube, Sectional Type, 200# Pressure Boilers.

ALBANY, GA.

1—1000 KW General Electric Turbo-Generator, 150# Pressure, Type ATB-2, Form T, 2300 Volts, 314 Amps., 3600 R.P.M., with Worthington Barometric Condenser.
1—600 KW Westinghouse Turbo-Generator, 2300 Volts, 187 Amps., 3 Phase, 60 Cycle, 3600 R.P.M., with Worthington Barometric Condenser.
1—500 HP Sterling Water Tube Boiler.
1—250 HP Walsh & Weidner HRT Boiler.
2—250 HP R. D. Cole HRT Boilers.



Water Tube Boiler #7. 518 H.P. with Westinghouse Single Retort Underfed Stoker—200 lbs. pressure. Actual photo as of January 1945. Boiler—Heine

REPUBLIC TEXTILE EQUIPMENT COMPANY

REFINANCING - APPRAISALS - PURCHASE - SALE - LIQUIDATION OF MILL PROPERTIES

PURCHASE AND SALE OF USED MACHINERY

40 Worth Street, New York 13, N. Y. **Cortland 7-1591**

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS
(Condensing)

5000 KVA (2) GE 2300 v.
3750 KVA Wghse. 600 v. (bleeder)
3750 KVA GE 2300 v.
3150 KVA GE 2300/4000 v.
3125 KVA GE 480 v. (bleeder)
2500 KVA Al. Chal. 2300 v.
2500 KVA Wghse. 600 v.
1560 KVA Wghse. 480 v. (bleeder)
1553 KVA Al. Chal. 480 v.
937 KVA (2) GE 2300 v.
750 KVA GE 2300 v.
500 KVA (3) GE 240/480 v.
375 KVA GE 2300 v.
312 KVA Elliott. 480/240 v.

A C TURBINE UNITS
(non. cond.)

300 KVA Al. Chal.-Kerr, 240 v.
375 KVA GE 2300 v.
312 KVA CW-Moore 240 v., 400#
110 KVA Al. Chal.-Kerr, 240 v.

BOILERS

880 HP B & W 200#
612 HP Sterling 250#
600 HP (6) B & W 200#
522 HP Kidwell, 207#
396 HP B & W 160#
328 HP (4) Sterling, 160#
305 HP Kidwell, 190#
300 HP (2) Union, 175#
275 HP (2) B & W 160#
250 HP (4) Wickes, 160#
231 HP B & W 250#
180 HP B & W 3 drum, 160#
150 HP HRT 152#
150 HP Erie Economic, 125#
125 HP Erie Economic, 100#

PUMPS (motor driven)

8000 GPM Al. Chal. 132' Head
7000 GPM Morris 80' Head
7000 GPM Morris (dredge pump)
3250 GPM Morris 425' Head
3000 GPM Al. Chal. 65' Head
1000 GPM Al. Chal. 246' Head
1000 GPM Morris 255' Head
800 GPM Al. Chal. 325' Head
725 GPM Wheeler, 30' Head
700 GPM DeLaval 85' Head
700 GPM Cameron 566' Head
470 GPM Dean-Hill 693' Head
420 GPM (2) Worthing. 630' Head
340 GPM Worthing. 208' Head

STEAM ENGINE SETS (AC)

312 KVA Wghse.—Skinner Unif.
250 KVA Wghse.—Nordberg Unif.
180 KVA G.E.—Chuse 4 v.

STEAM ENGINE SETS (dc)

300 KW G.E. 3 wire—Skinner Unif.
250 KW CW 250 v.—Skinner Unif.
150 KW GE 250 v.—Erie Ball, 4 v.

DIESEL ENGINE SETS (ac)

300 KVA Fairbanks Morse "VA"
219 KVA Burke—Buckeye

TRANSFORMERS

833 KVA (3) Wghse. 13200/2300
667 KVA (3) Al. Chal. 6930/2300-4000
667 KVA (3) GE 22000/460
500 KVA (4) Wghse. 11000/2300
500 KVA (2) GE 11950/6900-230/460
500 KVA (2) GE 6600-2300
400 KVA (3) GE 2300-440
250 KVA (2) Pittsburg 13200-460
250 KVA (9) Wghse. 6900-440/220
250 KVA (2) GE 6600-2300
250 KVA (3) Al. Chal. 4800-240/120
200 KVA (3) GE 13200/6600-575
200 KVA (3) GE 2400-240/120
150 KVA (3) GE 2300-240/120
150 KVA (3) GE 22000/33000-230/460
125 KVA (3) Wghse. 6600/2200-220/440
125 KVA (3) Bellis 440-17 to 24 v.
100 KVA (6) GE 6600-240/120
100 KVA (3) Wghse. 13200-2300

TRANSFORMERS (3 ph.)

850 KVA GE 13800-2300
750 KVA Wagner, 6600-2200
300 KVA GE 2300-460/230

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR GENERATOR SETS

KW	Make	DC	Volts	AC Volts
1200	G.E.	280	Syn.	3/60/4100
1000	G.E.	250	Syn.	3/60/4150
1000	G.E.	600	Syn.	3/60/2300
1000	Wtg.	275	Ind.	3/60/4100
750	Wtg.	275	Syn.	3/60/440
400	G.E.	250	Syn.	3/60/2300
225	Ideal	125	Syn.	3/60/2200
200	Elliott	125	Ind.	3/60/2200
150	Al. Ch.	250	Syn.	3/60/2300
100	Al. Ch.	125	Syn.	3/60/440
100	Wtg.	250	Ind.	3/60/2200
100	G.E.	250	Ind.	3/60/2200
100	G.E.	300	Syn.	3/60/440
100	G.E.	300	Ind.	3/60/440
75	G.E.	250	Ind.	3/60/440
75	G.E.	125	Syn.	3/60/220
60	Al. Ch.	110	Ind.	3/60/2200
50	G.E.	250	Ind.	3/60/440
25	G.E	230	Ind.	3/60/220
22½	G.E.	125	Ind.	3/60/220
15	Ideal	220	Ind.	3/60/220
10	G.E.	115/230		Balancer set
7½	G.E.	60	Ind.	3/60/440
7½	Jen	115/230		Balancer set
	Roth	125/250		Balancer set
3½	G.E.	230	Ind.	3/60/220
	Lincoln	115	Ind.	1/60/220
3	Lincoln	115	Ind.	1/60/220
3	Westg.	25	Ind.	3/60/220
2½	Acme	45	Ind.	3/60/220
2½	Wotton		Ind.	1/60/110/220
2.4	Lincoln	80	Ind.	3/60/220
3 HP	Roth	110	2 KVA	1/60/110
2	El Sp.	750	Ind.	3/60/440
1	Holts. C	65		220 D.C.
.5	Rob. M.	115		Variable voltage
.378	G.E.	110	Ind.	1/60/110
.250	Robbins	125	Ind.	1/60/125
.250	Roch.	120	Ind.	1/60/110/220
.2	G.E.	6		115 v.d.c.
.2	G.E.	6	Ind.	1/60/110/220

FREQUENCY CHANGERS

1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph., 60 cy., 460 volt, 300 RPM, 1570 amps., 1250 KVA, 0.9 P F 50° synchronous motor with amort. wdg.; dir./conn. to 1000 KW General Electric type AT-10-1250M-300, 3 ph., 25 cy., 460 volts, 300 RPM, 1570 amps., 1250 KVA, 0.8 P. F. 50° A C generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter

(This is a three brg. unit suitable for operation from either end.)

SLIPRING MOTORS
3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
2	2500	G.E.	MT	253
1	1000	Westg.	CW	450
1	1000	Westg.	HR	360
1	1000	G.E.		400
1	850	Allis Chal.		1180
1	800	Westg.	CW	360
2	800	Westg.	CW	507
1	800	Westg.	CW	900
1	750	Allis Ch.		440
1	750	G.E.	I-P	900
1	700	G.E.	MT-10	710
1	600	Westg.	with drive	350
1	600	West.	CW	390
1	500	G.E.	MT412	435
1	500	G.E.	MT412	450
1	450	G.E.	MT412	600
1	400	Westg.	CW	435
1	400	Allis Chal.		600
1	400	G.E.	I-M	720
1	400	G.E.		1200
1	400	G.F.	IP	1800
1	350	Allis Chal		300
1	350	G.E.	MT	300
1	350	G.E.	I-M	900
1	300	G.E.	I-24	293
1	300	Westg.	CW	400
1	300	G.E.	I-P	450
1	300	Westg.	CW	500
1	300	G.E.	I	514
1	300	G.E.		720
1	250	Westg.	CW	435
1	250	Cr. Wheeler	SR27QB	600
1	250	G.E.	IM	435
4	100	Ideal	2200	690

SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
1	1000	G.E. 2200 v.	K	509
1	700	G.E. 2200 drip-proof cons.	KF	1800
1	600	Fair Morse	H2	212
1	500	G.E.	IK	1200
1	500	Westg.	CS	1750
1	400	Allis Chal.		600
1	400	G.E.	I-M	950
1	400	G.E.	I-K	1800
3	250	Westg.	CS	350
1	250	Ideal	A	1200
1	225	G.E.	I-E	1800
3	200	A.C.	AR	3600
1	200	Allis Chal.	AN	347
1	200	Fair Morse		514
1	200	Westg.	CS	600
1	200	G.E.	IK	600
1	200	G.E.	KT566	720
3	200	G.E. 2200 v.		1800
3	200	Fair Morse	BB	1800
1	200	Westg.	CS	3600
2	200	G.E.	KTP	3600
1	150	Allis Chal.		570
1	150	G.E.	IK	600
1	150	Westg.	CS	1800
2	120	G.E.		720
2	150	G.E.	I-K	720
1	150	Allis Chal.		850
1	150	G.E.	K-558	900
1	150	Westg.	CS	1800
13	75	A.C.	AR	1800

DYNAMOMETERS

250 HP GE Sprague type C dynamometer, laboratory test type 250 volts 1200/1500 RPM with Scale beam & control panel, 50 HP G.E. Sprague block test type, 275 volts, 750/2000 RPM, with complete panel.

5—25 HP GE Sprague type LC shunt interpole, block test with control panels 825/2000 RPM.

1—Type TLC-110, 250 HP. 1000/3000 RPM 250 V. BB. All Complete.

SYNCHRONOUS MOTORS

HP	Make	Volts	Speed
600	G.E.	2200	600
500	G.E.	2200	720
500	G.E.	2200	450
300	G.E.	440	900
270	G.E.	440	600
190	E.M.	440	720
150	E M.	440	1200
5	G.E.,	220	1800

AIR COMPRESSORS

1—6x6 Chicago Pneumatic horizontal.
1—6x6 Gardner-Quincq 60 CFM 100# horizontal.

HOISTS

3—500 lbs. Cable type, 230 volt DC motors.
1—2000 lb. Detroit rope type hoist, 3/60/220 AC.

ARC WELDERS

2—300 amp Lincoln stable-Arc with bb motor, 3/60/220 AC.
1—400 amp Lincoln stable-arc with bb motor 3/60/220 AC.
1—300 amp Unaweld with 3/60/220 AC bb motor.

CHICAGO ELECTRIC CO.

1320 W. CERMAK RD.
CANAL 2900

CHICAGO 8, ILL.

WAGNER

"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

150 KW Allis-Chalmers gen. DC 250 volts, coupled to 250 H.P. Gen. Elec. Synch. motor, 3-60-220/440 volts
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage I-K motor 3-60-2200/4000 V.
50 KW Northwestern type 6HH9 rotary converter, input 3-60-220 V., output DC 230 V. with control panel.
50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440 V. 1800 RPM.
30 KW Gen Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.
20 KW Hertner gen. DC 125 v. coupled to 47 HP motor 3-60-220/440 V., 1160 RPM.

Many others available—special units built to order

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
100	Northw'n	interpole	230	1700
100	Reliance	1050T	230	500/1200
100	Sprague cradle dynamometer		250	1650/2500
50	G.E. Sprague (2)	LC	250	700/2000
50	Whse.	SA	230	450/1350
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
40	Whse. (2)	SK158	230	575
30	Sprague	LC	230	600/1200
30	Sprague	dynamom	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
20	Gen. Elec.	DLC	230	500/1500
20	Fair Morse	TR	230	325/700
20	Whse.	SK	230	850
20	Whse.	SK111	230	250/1000
15	Whse.	SK80	230	1150
15	Gen. Elec.	LC	230	550/1100
15	Gen. Elec.	CD83	230	1150
15	Whse. (6)	SK90	230	850
15	Gen. Elec.	CD95	115	575/1725

QUICK SHIPMENT FROM STOCK

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	150	Whse. New b. b.	CS771.18	1800
1	150	Gen. Elec. 2200 v.	I-K	900
1	125	Allis Ch. 2200 v.	AR	1800
1	100	Gen. Elec.	I-K	720
1	75	Whse.	CCL	720
1	75	Gen. Elec.	I-K	600
1	60	Century	AS40	1800
1	50	Allis Ch.	AN	900
2	50	Gen. Elec.	I-K	1200
1	40	Allis Ch.	AN	720
1	40	Gen. Elec.	I-K	1200
1	40	Gen. Elec.	KT332	1200
2	30	Allis Ch.	AN	1200
1	30	Allis Ch.	AN	600
6	30	Allis Ch.	AN	900
1	30	Whse. b. b. New	CS405	1800
2	30	Allis Ch.	AN	720
2	30	Gen. Elec.	KT326	1200
2	25	Gen. Elec.	KT302	1800
3	25	Gen. Elec.	KT322	1200
3	25	Allis Ch. b. b.	ART	1200
4	25	Allis Ch.	AN	900
1	25	Allis Ch.	AN	600
2	25	Diehl New b. b.	IN365	1800
1	25	Louis Allis b. b.	HD	1200
1	25	Whse. New	CS405	1200
6	20	Whse. New	CS364	1800
1	20	Wagner	17TBW	1800
2	20	Gen. Elec.	I-K	1200
3	20	Whse.	CS	900

25 CYCLE MOTORS

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
300	Whse.	CW sl. rg.	590
150	Whse.	HD sl. rg.	500
150	Gen. Elec. 2200 v.	MT359 sl. rg.	1500
100	Whse.	CCL sq. cg.	500
100	Gen. Elec.	I-K	750
50	Allis Ch.	ANY sl. rg.	1500
30	Allis Ch.	sq. cage	750

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	ped.	220/440	900
250	G. E. 1-brg.	ATI	220/440	600
190	Gen. Elec.	ATB	220/440	600
150	Gen. Elec. 3 brg.	TRB	220/440	450
50	Ideal	Late	220/440	900
50	Burke		220/440	1200

CENTRIFUGAL PUMPS
14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	400	G.E. 2200 v.	I-P	1200
1	350	Allis Ch.	ANY	514
1	300	Burke	EMV	225
1	175	Lincoln	LXV	600
1	150	Gen. Elec.	I-M	600
2	150	Triumph	SR	514
1	100	G.E. 2200 v.	I-E13A	1800
1	100	Gen. Elec. 3 brg.	I-M	450
1	100	Whse.	CW	1200
1	75	G.E. 2200 v.	I-E13	1800
1	75	Gen. Elec.	MT558	600
1	75	Gen. Elec. 2200 v.	I-M	900
1	65	P. & H. b. b. Int.	CA16	900
2	60	Whse. 2200 v.	CW657	1800
3	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Al. Ch. b. b. 2200 v.	ARY	900
1	50	Gen. Elec.	MT342	900
1	50	Gen. Elec.	I-M	600
1	40	Gen. Elec. 2 ph	MQ536	900
1	40	Northw'n	HW35A	1200
2	40	Gen. Elec.	MT532	1200
1	40	Fair Morse b. b.	HV	900
1	40	Whse.	CW	900
1	40	Watson b. b.	KHV	1200
2	40	Allis Ch.	ANY	450
1	35	Fair Morse b. b.	HV	1800
2	30	Northwestern b. b.	HW404	1800
2	30	Allis Ch.	ANY	900
2	30	Whse. enclosed	MA	600

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
250	Northern		250	360
150	Allis Ch.		250	600
40	Whse.	SK	250	720
35	Gen. Elec.	DLC	250	900
30	Lincoln b. b. 600 amp.		50	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	LC	250	900
19	Gen. Elec. 300 amp.	CD	65	1200
16	Cr. Wheeler	CCD	125	415

ALSO IN STOCK . . . OIL SWITCHES BLOWERS & FANS . . . SPEED REDUCERS . . . 500 NEW MOTORS

60 CYCLE A. C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
500	Gen. Elec. 3 brg.	ATB	2300	450
300	Allis Ch.		240/480	600
300	Whse.	ped.	240/480	900
300	Elec. Machy.		240/480	720
250	Gen. Elec.	ATB	240/480	600
200	Gen. Elec.	TRB	240/480	720
125	Whse.	ped.	2300	600
100	Allis Ch.		240/480	900
100	Cr. Wheeler		240/480	600
50	Gen. Elec	ATB	240/480	1200
40	Burke		240/480	1200

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409

IT TAKES 120,000 SQUARE FEET OF WAREHOUSE SPACE TO HOUSE OUR COMPLETE LINE OF ELECTRIC MOTORS, POWER PLANT EQUIPMENT and REBUILDING SHOPS!

IN EXCESS OF 12,000 ITEMS ARE AVAILABLE, TOO NUMEROUS TO LIST. ADVISE US YOUR REQUIREMENT

AC & DC MOTORS
—GENERATORS
SYNCHRONOUS MOTORS
MOTOR-GENERATOR SETS
STEAM ENGINE-GEN. SETS
SLIP RING MOTORS
CONTROL EQUIPMENT
PUMPS
ELECTRIC HOISTS

IN BUSINESS SINCE 1905

THE GLOW ELECTRIC COMPANY

933-943 HARRIET ST. — Phone MA. 3024 — CINCINNATI 3, OHIO

TURBO GENERATORS

1—937KVA Gen. Elec. with Wheeler condensor
1—500KW Allis Chalmers Moore non-cond.
1—500KW Gen. Elec. non-cond.
1—300KW Gen. Elec. cond.

ROTARY CONVERTERS

1—1500KW 250V Westgh complete
2—1000KW 250V Westgh complete

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generator, Engine Generators, Motor Generators, transformers, Circuit Breakers, etc. Please send us your inquiries.

What have you for sale?

KEYSTONE

Power Plant Equipment Company

8403 Hegerman St., Phila. 36, Penna.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS

3 phase, 25 cycle, 220/440 Volts

HP	Make	RPM	Type	Frame
(3)2	Westg.	500	CS284	T.E.F.C.B.B.
2	Gen. Elec.	750	K	254
2	Allis Chal.	750	AR	
2	Westg.	1500	CS	231
2	Gen. Elec.	1500	KT	934
3	Fair. Morse	750	B	
3	Rob. & Myers	750	K	204
3	Reliance	715	ball bear.	
3	Gen. Elec.	750	KT	750
3	Master	1500	PA	ball bear.
3	Master	1500	PA	ball bear.
(12)5	Westg.	750	MS	
5	Northw'n	1430	H3A	
(3)5	Valley Elec.	1500	718	vertical
7½	Westg.	500	CS	
7½	Gen. Elec.	750	KT	954
7½	Allis Chal.	720		
(3)7½	Westg.	750	MS	
(5)7½	Westg.	750	CS	
7½	Gen. Elec.	1500	KT	181
7½	Wagner	1450		
10	Westg.	500	CS	
10	Gen. Elec.	500	I	form K
10	Wagner	500	BP	
(2)10	Westg.	500	MS	
(2)10	Gen. Elec.	750	KT	512
10	Cr. Wh.	720		
(7)10	Wagner	710	19TBM	
15	Gen. Elec.	750	I	form K
(3)15	Westg.	710	MS	
(2)15	Allis Chal.	725		
15	Westg.	1500	CCL	
15	Gen. Elec. 1500/423	tot. enc.		back geared

MOTOR GENERATOR SET

1—125 KW Ridgeway 250 V. DC 1200 RPM. direct connected to 180 HP. Ridgeway Motor 3/60/440 Volts 1200 RPM. DC. Panel and Starting Compensator.

FREQUENCY CHANGER SET

1—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM direct connected to Generator 362½/440 V. Complete with exciters and panels.

TRANSFORMERS

3—150 KVA. General Electric Type H, Form KS, 2400 Volts Primary 120/240 Volts Secondary.

REBUILT MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Crocker Wheeler		600	131413
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	944593
20	Westinghouse	CS	1200	2160590
20	Star	BB404	1200	10581
20	Westinghouse	MS	1200	1056826
20	Westinghouse	MS	1200	1246745
20	Westinghouse	MS	1200	1056827
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	1930159
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Armor	BB	720	4343
30	Crocker Wheeler		720	17270
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CCL	350	581480
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	General Electric	I-K	1800	68511
40	General Electric	I-K	1800	77017
40	General Electric	I-K	1800	73316
40	Westinghouse	MS	1800	1506800
40	Westinghouse	MS	1800	1051548
40	Westinghouse	MS	1800	1056802
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	CCL	400	541841
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	Westinghouse	CS	1800	1949877
50	General Electric	14	1800	181444
50	Reliance		1800	Z20194
50	Allis Chalmers		1800	3K28825
60	Westinghouse	CS	900	4884402
60	Reliance		1200	B11458
60	Westinghouse	CCL	450	518408
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
75	Westinghouse	CCL	514	450185
75	Westinghouse	CS	1800	2134671
100	Westinghouse	CCL	600	416173
100	Westinghouse	CS	900	2207524
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)
125	Westinghouse	CCL	720	427284
125	Westinghouse	CS	1200	2318625
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	General Electric	KT557	1200	5269860
150	General Electric	KT557	1200	5260126
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	720	122809 (2200 v.)
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	I-K	600	2246834
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845

SLIP RING MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
1	Westinghouse	CW	1200	5348371
1	General Electric	MT122	1200	232163
1	General Electric	MT122	1200	3797628
1	General Electric	MT122	1200	2323624
1½	General Electric	MT140	1200	1416002
1½	General Electric	MT140	1200	811798
15	General Electric	I-M	900	1225064
15	General Electric	MT322	855	3088717
13	K.W. Sachsenwerk	D7-3/8	850	295481
20	Westinghouse	CW644C	575	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	1558408
40	Westinghouse	CW748	690	4406823
40	Westinghouse	CW748	690	4406825
40	Westinghouse	CW748	690	4406821
40	Westinghouse	CW748	690	4406819
40	Westinghouse	CW748	690	4405824
250	Allis Chalmers	3 bearing	505	104390 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

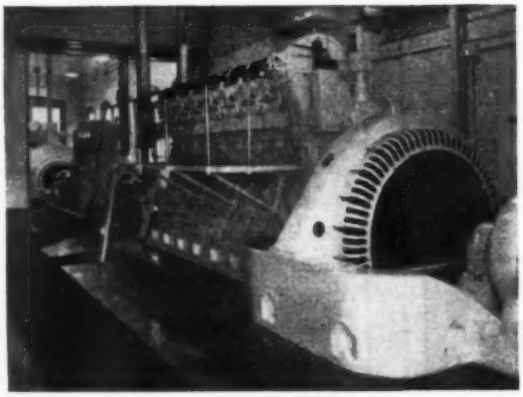
ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

OUTGROWN

COMPLETE DIESEL POWER PLANT

FOR SALE



575 KW CAPACITY

INSTALLED 1937-38

4 cycle Mechanical Injection

1—375 HP—250 Kw McIntosh Seymour

1—320 HP—225 Kw Winton

1—150 HP—100 Kw Superior

Complete with Evaporative Coolers, Pumps, Switchboard and all Piping and Accessories. Can be seen operating.

Phone or Write

GUSTAVO PRESTON COMPANY

113 BROAD ST. TEL. HANCOCK 3995 BOSTON, 10, MASS.

SMALL COMPLETE PLANT—BARGAIN

1—500 KVA Allis turbo generator 60/3/2300V/3600 RPM with surf. cond. all auxs. Boilers: 1—350 HP B&W 160#, 1—240 HP 160# Stirling. 2—oil burning, 6—gas burners. 1—duplex Steam pump. 1—feed water heater—Other Plants Complete.

NON-COND. TURBOS

1—1000 KW Wemco 60/3/2300V/1800 RPM/150# 10# B.P.
1—1000 KW Wemco turbine. 350#, 700° T.T.—gen. new or used avail.
1—1000 KW G.E. 60/3/480V. 150# 100° S.H. 30# B.P.
1— 500 KW G.E. 60/3/2300V. 100-125#, 2# B.P. New 1924.
1— 300 KW G.E. 60/3/240V. Bleeder, 4000# per hr. 10# B.P.
1— 500 KW Wemco mult. exp. parallel flow 60/3/440V/3600 RPM 150-200# 10# B.P.
1—750 KW Moore 200# 100° S.H. 10# B.P. 75# ext. with 2—633 HP boilers.

COND. TURBOS

1—6000 KW Wemco 76 CW, 60/3/2300/225# equal new.
1—4000 KW G.E. 60/3/2300V/200# 125° S.H. surf. cond.
1—3000 KW G.E. Curtis 60/3/2300V/150# surf. cond.
1—2000 KW Wemco 60/3/440V/180# surf. cond.
1—1250 KW Wemco Bldr. 60/3/480V/150#/120° S. H. 3600 RPM Bldg. 15#G, 15,000# per hr.
1—1250 KVA Allis A.C. 60/3/2300/3600 RPM 150-200#, 100° S.H.
1—1560 KVA Wemco A.C. 60/3/600/3600 RPM mixed flow Wemco 4200 sq. ft. surf. cond.

ASME BOILERS

1—1250 HP steam generation plant complete. Superheater, Economizer, Steel encased 14 retort stoker, 100,000# Cont.
2—612 HP 200# 125° S.H. Stirling.
4—500 HP Hine 190# 150° S. H.
2—500 HP B&W 200# 100° S.H. Comb. Eng. Type E stoker all auxs.
1—500 HP Edgemoor 175# Comb. Eng. Type E stoker.
2—365 HP Edgemoor 200# 100° S.H. Ram type stoker.
1—313 HP 250# Edgemoor 125° S.H. stoker.
1—200 HP Brownell HRT 125# New 1936; Stoker.
2—125 HP Leffle Scotch Marine 125# Oil Burners.
1—305 HP Kidwell 185#, 125° S.H. Stoker.

50 YEARS OF SERVICE

LET US PLACE YOUR MODERN IDLE EQUIPMENT

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
20	Westg.	220	1735	CW
20	Westg.	220	575	CW
20	Allis Chal.	440	1130	
20	Allis Chal.	440	680	
25	Westg.	220	720	CW
30	Westg.	220	900	CW
30	West.	220	1800	CW
40	Triumph	440	1760	
50	Westg.	440	1145	HF
50	Chandeys'n	220/440	1800	
50	Allis Chal.	220	490	
75	West.	220/440/2200	580/290	CW
100	West.	220/440	685	CW
150/75	West.	220/440/2200	580/290	CW
150	West.	2200	375	CW
150	West.	2300	490	CW
150	West.	220/440	490	CW
260	Burke	440	600	EMV-65
300	G.E.	440	900	I
400	Westg.	2300	580	CW
400	Westg.	2200	435	CW-1214
1500	Westg.	2200	435	3W

ALTERNATING CURRENT MOTORS 3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
25	West.	220/440/550	1200	CS
25	Lincoln	440	900	
30	G.E.	440	1800	KT
30	Triumph	220	525	TR-133
30	Allis Chal.	220/440	1200	
40	Powell	220	900	SO
40	G.E.	440	1800	KT-527-4
40	Triumph	440	1760	S8825
40	Lincoln	440	1800	Flev.
40	G.E.	440	900	KT
50	G.E.	220	1200	
50	Fair Morse	220	900	
50/150	West.	2200	360/720	CS-954
50	West. El.	220	570	KT-346
50	Chandeys.	220/440	1800	
50	Cr. Wh.	240/480	1200	Syn.
50	Allis Chal.	440	1800	AN
50	G.E.	220/440	1200	HI
50	G.E.	440	1160	KT
50/32	G.E.	440	800/640	
60	G.E.	220	1200	
100	Allis Chal.	220	1750	
100	Allis Chal.	220	600	
150	Wagner	440	1800	3IV
150	G.E.	2200/220/440	450/243	
175	G.E.	2200	600	I-12
200	Westg.	2200	900	
1000	G.E.	2300	509	K
1500	G.E.	2200/220/440	225	ATI-Syn.
3500/4000	West.	4000/23000	900	Syn.

VARIABLE SPEED MOTORS—230 VOLT D.C.

H.P.	Make	R.P.M.	Type
1.5	Roth	850/1700	
2	Star	400/600	SB
2	G.E.	400/1600	RLC
2	G.E.	415/830	RLC
2	Reliance	550/2000	
2¼	Westg.	450/900	SK-30
2½	G.E.	500/1000	RLC
2½	Reliance	500/1000	14T
3	Jantz-Liest	650/1950	BI-DC
3	Roth (Enclosed)	500/1000	RS
3	G.E.	400/1200	RLC-114
3¼	Westg.	400/1600	SA
3½	Westg.	850/1700	
5	Reliance	600/1800	
6	Roth	500/1000	
7½	Westg.	450/900	80L
7½	Reliance	650/1300	550v
7½	Westg.	1125/2905	SK-43
7¾	Westg.	400/1600	SA
10	Westg.	565/1130	S-6
10	G.E.	625/1250	LC
10	West.	400/1600	SA
15	Reliance	500/1800	
20	Westg.	750/1500	SK-110L
30	G.E.	450/900	RLC
75	West.	475/950	SK-180
75	West.	400/650	SK-181

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
6	Ilg.	230	380	
7½	West.	220	700	L
10	West.	230	750	MT-00
15	West.	230	650	MT-00
15	Cr. Wh.	220	270	SM
15	West.	220	650	RL
25	West.	230	600	MT
32	Shaw	230	485	5L2E
68	G.E.	220	475	
80	West.	230	490	76-A
175	G.E.	230	475	MD

TRANSFORMERS—1 ph. 60 cy.

No	KVA	Pri.	Sec.	Make
1	2	6600	110/220	G.E.
3	5	2300	220/440	G.E.
1	5	2200	110/220	West.
84	7½	2200	220/110	G.E.
32	7½	2200	220/110	West.
12	10	2200	220/110	West.
13	10	2200	220/110	G.E.
2	15	400/30000/50000		American
1	25	2200	220/110	G.E.
6	35	220	110	West.
3	50	6600	575/440/220	G.E.
2	50	6600	550/440	Pgh.
2	50	6600	550/440	Al. Ch.
2	150	2400	240/480	Allis Chal.
6	73	2200/4000	220/110	West.
6	73	440	205	West.
1	75	2200	220	Burke
6	75	2200	220/440	West.
3	150	2400	240/480	Allis Chal.

HOIST

1—3 ton Westghse Hoist with Westghse DC Mtr., 1600 rpm.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari time magnetic controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS 250 volts

1—kw Allis Chalmers 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—7½ kw West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—10 kw. West. 8K 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—15 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—20 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—25 kw. Triumph 1750 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—25 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—55 KW 230 v. DC 1200 rpm. West. Gen. dir. conn. to 75 HP 1200 rpm. 2300 v. motor.
1—150 kw. West. 250 v. 900 rpm. Gen. dir conn. to 290 HP 440 v. 3 ph. 60 cy. West. Syn. Motor.
3—250 kw. Cr. Wh. 250 v. 500 rpm. DC Gens. with 3—250 kva. Cr. Wh. Syn 2200 v. 3 ph. 25 cy. Motors.

125 volts

1—5 kw. 125 v. 1150 rpm. Allis Chal. Gen. dir. conn. to 3 ph. 60 cy. 220/440 v. AC Induction Motor.
1—50 kw. G.E. 1200 rpm. Gen. direct driven by 2200/440/220 v. AC Induction Motor.

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

DUQUESNE ELECTRIC MFG. CO. **Pittsburgh 6, Pa.**

MOTORS

230 VOLT DC MOTORS
Constant Speed

Qua.	HP	Make	Type	Speed
1	400	Al-Ch		415
1	125	Gen Elec	DLC	550
2	75	West	S-130	475
2	50	West	SK-160	565
3	40	Gen Elec	DLC	610
1	30	West	SK-140	600
2	30	Gen Elec	RC-31B	1150
1	25	West	SK-120	825
1	25	West	SK	1100
5	25	Gen Elec	RC-31	1150
5	15	West	SK	675
11	15	Gen Elec	RC	800
2	15	West	SK	825
10	15	Gen Elec	RC	1150
13	10	Gen Elec	RC	850
1	10	Gen Elec	RC-9	1150
5	10	West	SK-40	1750
1	10	Watson	AW-9B	1500
2	7½	West	SK	850
1	7½	Gen Elec	RC	850
30	7½	Cr Wh	CCM	875
1	7½	Eck	712	1750
27	5	West	SK-40	850
1	5	Starr BB	SBF-3	3600
1	2	West	SK	680
1	2	Hobart		1750
1	2	Robbins & Myers		1750

230 VOLT DC MOTORS
Variable Speed

1	125	Gen Elec	CL	310/900
1	100	West	SA	250/350
2	40	Gen Elec	LC	650/1300
3	30	West	SK	600/1200
1	16–17½	West	SK	600/1200
6	15	Gen Elec	RF-10	550/1650
1	15	West	SK	400/1600
1	15	West	SA-9	300/1200
1	10	Gen Elec	RF-10A	600/1800
1	8½	West	SK	350/1400
1	7½	West	SK	400/1600
7	3	Roth Bros		500/1000
4	2½	West	SK	500/1000
20	2	Gen Elec	RLC	415/830
1	2	West	SK-23	700/2100

BOILERS

4—1010 HP Heine Water Tube Boilers, 250 lbs. pressure, complete with Superheaters, Bethlehem Dahl Oil Burners, all valves, piping and fittings.

2—440 HP New Westinghouse single retort moving grate stokers, complete with hydro feed drives, blowers and all accessories. Will operate at 200% of rating. Never installed.

SQUIRREL CAGE MOTORS
220/440 V. 3 ph. 60 cyc.

Qua.	HP	Make	Type	Speed
1	400	West	CS	690
2	150	Al Ch (2200 v.)		1185
1	100	GE (2200 v.)	IK	500
1	75	Al Ch		900
1	75	Al Ch		600
1	50	Al Ch		900
1	40	Reliance		860
1	30	Wagner		600
3	30	Wagner		720
1	25	Al Ch		900
1	15	Century	SCN-19	1200
1	10	Gen Elec	IK	1200
2	7½	Al Ch	AN	1150
5	3	Imperial	224	3600

Synchronous—Slip Ring

1	150	G E (Syn.)	ATI	900
1	150	Al Ch (Sl R)	3 brg	600
1	75	G E (Syn)	ATI	900

MOTOR GENERATOR SETS

50 KW Westinghouse SK 150L-1200 RPM, 125 volt DC, connected to 75 H.P. CS-764, 2200 volt, 3 phase, 60 cycle, 1200 RPM motor.

TURBO GENERATORS

6250 KVA Westinghouse Turbo-Generator Set:
Turbine 3600 RPM, 200 lbs. pressure, 125° Superheat, complete with condenser, pump and air washer. Generator: 6250 KVA, 3 phase, 60 cycle, 2300 volt, 3600 RPM, with turbo-exciter and Motor Generator Exciter.

75 H.P. Westinghouse Turbine, non-condensing: 200 lbs. pressure, 7200 RPM, connected thru reduction gear to 50 KW 125 volt DC Generator, 1200 RPM.

750 KW Ridgway Elliott-Turbo Set, mixed pressure, 1800 RPM, 230 volt DC.

WRITE US ABOUT YOUR REQUIREMENTS

Heat and Power
COMPANY
45 BOND ST. • ALGONQUIN 4-3874 • NEW YORK 12, N. Y.

IMMEDIATE DELIVERY

ELECTRIC MOTORS
Direct Current—230 Volts

1—10 HP Crocker Wheeler—Type CM—825 r.p.m.
1—10 HP Crocker Wheeler—Type CCM—825 r.p.m.
1—10 HP Crocker Wheeler—Type CM—870 r.p.m.
1—15 HP Crocker Wheeler—Type CM—800 r.p.m.

Direct Current—115 Volts

1—25 HP Westinghouse—Type S—630 r.p.m.
1—17.5 HP Crocker Wheeler—Type CM—340 r.p.m.
1—10 HP Crocker Wheeler—Type CCM—1750 r.p.m.
1—10 HP Crocker Wheeler—Type CM—580 r.p.m.
1—20 HP Crocker Wheeler—Comp.—1200 r.p.m.
1—7.5 HP B.F. Sturtevant — Type MP4 — 550 r.p.m.
1—7.5 HP Crocker Wheeler—Type CM—875 r.p.m.
1—3.75 HP Crocker Wheeler—CM—440 r.p.m.
1—6 HP Crocker Wheeler—Type EM—960 r.p.m.
1—5 HP Sprague Elec. Co.—Slip Ring—520 r.p.m.
1—5 HP Sprague Elec. Co.—Slip Ring—520 r.p.m.
1—5 HP Crocker-Wheeler—Type CM—950 r.p.m.
1—5 HP Sprague Electric Co.—Lundell Motor Cont.—1050 r.p.m.
1—4 HP Sprague Electric Co.—Lundell Motor Cont.—815 r.p.m.
1—4 HP Crocker-Wheeler—CCM—1375 r.p.m.
1—2 HP Holtzer & Cabot Elec. Co.—Type C—250 r.p.m.
1—2 HP Sprague Elec. Co.—Lundell Motor Cont. —800 r.p.m.
1—¾ HP Crocker-Wheeler—Type SM—600 r.p.m.
1—⅓ HP Sprague Elec. Co.—Type RT—725 r.p.m.
1—3 HP Western Elec.—Type CVC Shunt—1100 r.p.m.
1—1 HP Crocker-Wheeler—Type CM—1200 r.p.m.
1—2 HP Crocker-Wheeler
1—½ HP Crocker-Wheeler—Type CM—550 r.p.m.
1—2 HP Sprague Elec. Co.—Lundell Motor—1150 r.p.m.
1—1.7 HP Crocker-Wheeler — Type CM — 1100 r.p.m.
1—2 HP Crocker-Wheeler—Type CM—1487 r.p.m.
1—7.5 HP Crocker-Wheeler—Type CM—385 r.p.m.

MISCELLANEOUS
Induction Type—220 V.—2 Ph.—60 Cy.

1—5 H.P. Burke—Type EB 5—1130 R.P.M.
1—5 H.P. Burke—Type EB 75—900 R.P.M.
1—7½ H.P. Robbins & Myers—Type K—850 R.P.M.
1—10 H.P. Burke—Type EM 1.2—1200 R.P.M.
1—10 H.P. Burke—Type EM 1.2—900 R.P.M.
2—20 H.P. Burke—Type EM 3—1200 R.P.M.
1—20 H.P. Crocker Wheeler—1170 R.P.M.
1—35 H.P. Burke—Type EM 4.5—900 R.P.M.
1—50 H.P. Burke—Type EM 4.5—1200 R.P.M.
1—150 H.P. West—Type CW—1765 R.P.M.

GENERATORS

One 250 K.V.A. and one 300 K.V.A. Crocker Wheeler Generators direct connected to Skinner Tandem compound engines—480 volts—3 phase 60 cycle, switchboard, instruments, piping.

One 300 K.W. General Electric Generator, 2300 v., 3 ph., 60 cy., direct connected to Curtis Steam Turbine, 175 lbs. pres.—3600 R.P.M. with 15 K.W. G.E. direct connected exciter.

EMSCO EQUIPMENT CO.
EMIL A. SCHROTH, Owner
50 Hyatt Ave. Newark 5, N. J.
Phone Mitchell 2-3536

We offer the following equipment:

1—Sterling gas engine, Viking model 2-C, 6 cyl., 8" bore, 9" stroke, 1200 RPM, 425 HP direct connected to Allis Chalmers synchronous motor 300 HP, PF 70%, 2200 volt, 91 amp., 3 phase, 1200 RPM, #117084 with direct connected exciter, #117085, 125 volt, 44 amp. Offered rebuilt and guaranteed at $5,000.00.

1—Fairbanks Morse type Y, style VA, needle bearing Diesel engine direct connected to 90 KVA, 257 RPM, 220 volt, 3 phase, 60 cycle generator complete with exciter and panel board, air tank, gas driven air compressor, fuel tank and cooling equipment. Like new, $3,000.00.

1—Fairbanks Morse two cylinder, back flow scavenging, 257 RPM, style YVA Diesel engine with Woodward Governor direct connected to General Electric 90 KVA, 2300 volt, 3 phase, 60 cycle, alternator complete with belted exciter. New in 1942, offered at $6,000.00, rebuilt and guaranteed.

PORTER ELECTRIC COMPANY

612 Third Ave. South GEneva 8655 Minneapolis 2, Minn.
ELECTRIC POWER PLANT EQUIPMENT COAST TO COAST

FOR SALE

DIESEL GENERATING UNIT M.A.N. built by Nelseco 375 KVA complete 3/60—2300 volt, used 10 years as standby

also

1—100 KW 900 RPM Alternator, various diesel and steam generating units, industrial and marine.

1—Steam reciprocating 50 K. W. 110 volt D. C. Marine Set.

Arnessen Electric Co.

116 Broad St., New York 4, N.Y.
Bowling Green 9-8542

SLIP RING MOTORS
3-HP., 60-CY

HP	Volts	Make	Speed
900	2200	G.E.	900
350	220/440	G.E.	1800
300	2200	G.E.	1800
300	2200	Whse.	514
300	440–220	Al. Ch.	900
240	2300	G.E.	600
240	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–400	G.E.	600
150	440–220	G.E.	1800
150	440	G.E.	1800
150	550–2200	G.E.	1500
150	550	G.E.	720
125	2200	G.E. (NEW)	1800
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
100	440–220	G.E. MTC	900
75	220–440	G.E.	900

SYNCHRONOUS MOTORS
3-HP., 60-CY

600	2200	Whse.	900
350	440–220	G.E.	900
300	440/220	Al. Ch.	600
300	2300	Whse.	900
110	440	Whse.	900
100	2200–550	Al. Ch.	1800
100	440–220	G.E.	360
75	440–220	G.E.	720

PUMP

1—4" Dredge Pump 1330 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

UNAFLOW ENGINE-GENERATOR SET consisting of:
Gen: 250 KW 200 RPM 250 volt direct connected to:
Eng: 23" x 24" Ames Unaflow 125/150# ga. non-condensing. Very modern—practically new.
1—11" x 12" Ames non-condensing Steam Engine, direct connected to a 60 KW Crocker-Wheeler 250 volt DC Generator.

TRANSFORMERS
60 CYCLE

3—500 Kva., G.E., Type H, Form KDD 12300-2300 V.
2—500 kva., G.E., type H, form KS, 13800-230/460
3—333 kva., G.E., type H-KDD 2400-400/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H, 24500-2300 V.
1—200 kva., G.E., type HT, 12300/26400/460 V. 3 ph.
3—150 kva., G.E., type H KDD, 6600/11450Y 1300 V.
3—150 kva., G.E., type H-KDD 13200-2300.
3—150 kva., Al. Ch., type OISC 10400-2400.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., G.E., type H-KR 6600/11450Y-2300 V.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120
3— 50 kva., whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	1800
250	2200	Whse.	CS	1200
250	440/220	G.E.	IK	1800
200	220/440	G.E.	IK	720
200	440/220	G.E.	IK	900
150	440/220	G.E.	IK	900
150	2200	Allis Ch.	AN	450
150	440/220	Whse.	CS	514
125	440/220	G.E.	KT	1200
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	K1	720
75	2200	G.E.	KT	900
75	2300	G.F.	IE-K	1800
60	550	G.E.	FT	3600
50	220/400	G.E.	K	1800

MOTOR GENERATOR SETS

1—125 KW, 125 V., 1200 RPM, G. E. conn. to 175 HP, 1200 RPM, 440 V. 3 ph. 60 cy. Syn. motor.
1—75 KW, 250 V. 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V. 850 RPM, Whse. conn. to 75 HP, 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.

A.C. GENERATORS

1—500 kva., 900 r.p.m., 2200 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—187 kva., 900 r.p.m., 550 V. Whse.
1—110 kva., 900 r.p.m., 440 V., G.E.
1— 96 kva., 360 r.p.m., 480/240 V. G.E.
1—62½ kva., 1200 r.p.m., 2200 V. Cr. Wh.
1— 60 kva., 720 r.p.m., 240/480 V., G.E.
1— 25 kva., 3600 r.p.m., 220 V., G.E.

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HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

SYNCH. CONVERTERS

500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

500 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM
300 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM
200 KW G.E. IND. 600 V. 2300/4000 A.C. 1200 RPM

Each unit listed above is owned by us and is available now for immediate purchase.

WALLACE E. KIRK CO.

Incorporated

502 Grant Building Pittsburgh, Pa.

375 KVA Turbo Generator Non Cond. 150#
670 CFM Diesel Compressors 50# pres.
115 CFM Diesel Compressor 100# pres.
50 KW.3/60/240 Caterpillar Diesel Set

STEPHEN A. DOUGLASS CO.

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STEAM—ELECTRIC—HYDRO—DIESEL

"Export Orders Carefully Executed."

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1—2000 H.P. B.& W., 200# Boiler
2—1060 H.P. Heine Boilers 200#
4—1000 H.P. Heine 225# Boilers
2— 750 H.P. Edge Moor 200# Boilers
2— 750 H.P. B. & W. Sterling Boilers 200#
4— 600 H.P. B. & W. 200# Boilers
2— 600 H.P. Edge Moor 200# Stokers
1— 600 H.P. B. & W. Stirling 200# with Stoker
6— 440 H.P. B. & W. Sectional 200# Oil fired
Smaller Boilers and Fire Tube Boilers also

1—15000 K.W., G.E. Co., Turbo-Generator Condensing
1—10000 K.W., G.E. Co., Turbo-Generator Condensing
1— 5000 K.W., G.E. Co., Turbo-Generator Condensing
3— 4000 K.W., G.E. Co., Turbo-Generator Condensing
2— 2500 K.W., G.E. Co., Turbo-Generator-Condensing
2— 2000 K.W., G.E. Co., Turbo-Generator Condensing
1— 2000 K.W., W. E. & M. Co., Turbo-Generator Con.
3— 1000 K.W., G.E. Co., Turbo-Generator Condensing
2— 750 K.W., G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller. And Non-Cond. Units

50 Ton 69'-10" Overhead Traveling Crane.

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Motor Generator Sets—Synchronous Motors, Etc.

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VERTICAL MOTORS

1—Reliance fan-cooled 25 HP 1750 RPM 220/440 Volt

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A. C.

1—Ideal 3-bearing 250 HP 600 RPM 440 Volt
1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS, 3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTOR SPECIAL
3 phase, 60 volts

5—West. frame 405, 20 HP 900 RPM TEFC 220 Volts

D. C. EQUIPMENT, 230 VOLT

1—G.E. MPC 150 HP 262/750 RPM
1—Triumph 110 HP 292/600 RPM
1—Diehl 125 HP 400/1200 RPM

A large number of adjustable speed D.C. motors from 5 to 100 HP.

ALTERNATORS SPECIAL, Allis-Chalmers, 125 KVA 277 RPM 3 Phase, 60 Cycle

The Electric Motor & Repair Co., Cuyahoga Falls, O.

Rot. Con.—M-G Sets 3 ph. 60 cy.

2—300 KW G E. HC 12 Rotaries 275 v. 6 ph. with 2300 v. 3 ph. 60 cy. Transformers.
200 KW Ridg. 250 v.—2200 v. 1200 RPM.
150 KW G.E. 275 v.—2200 v. 1200 RPM.
100 KW G.E. 275 v —2200 v. 900 RPM.
75 KW G.E. 125 v.—220/440 v. 720 RPM.
50 KW G.E. 125 v.—220/440 Ind.
25 KW West. 250 v.—220/440 v. 1200 RPM.

AC and DC GENERATORS

200 KVA G.E. 2200/3/60 720 RPM. AC.
75 KW G.E. 125 v. 700 RPM. DC.
50 KW G.E. 125 v. 1750 RPM. DC.
.45 KW West. SK 125 v. 700 RPM. D.C.

AC & DC STEAM GEN. SETS

100 KW West. 250 v. DC—Skinner.
57½ KVA Al. Ch. 220/3/60 3600 RPM Turbo.
50 KW West 125 v. DC—Skinner.
50 KW 125 v. DC Westgh. Turbo Gen.

AC MOTORS 3 ph. 60 cy.

HP	Make	Type	Speed	Wdg.
1500	West.	CW	435	S.R.
1000	G.E.	KT	514	S.C.
500	G.E.	MT 412	435	S.R.
300	West.	CW	1750	S.R.
200	G.E.	IM	495	S.R.
200	West.	.8 P. F.	900	Syn.
200	G.E.	MT 412	240	S.R.
187	G.E.	IM	600	S.R.
150	West	CS	585	S.C.
150	West.	CW	375	S.R.
150(2)	West.	CCL	600	S.C.
150	G.E.	IL	600	S.C.
100	G.E.	IK	1150	S.C.
100	G.E.(25 cy)	MI 108	490	S.R.
100	Al. Ch.		690	S.R.
100	West.	CI	1750	S.R.
50/12½	G.E.	IM	450/900	S.R.
50	G.E.	KT	1160	S.C.
40	Triumph	TR	1760	S.C.
25	G.E.	KT	1160	S.C.
25	West.	CW	575	S.R.

Also large number of smaller motors.

MISCELLANEOUS

2—170 cu. ft. 100# Pres. Chic. Pneu. 9x8 simplate valve compressors—AC or DC Motor.
1—355 cu. ft. 100# 12 x 10—ER 1 Ing. Rd.
100 HP. American sgl. friction drum Hoist.
500/700 HP Morse Chain 4.28 to 1.
250 HP Falk Gear 12.7 to 1.
150 HP Nuttal 1.6 to 1.

DC MOTORS

HP	Make	Type	Speed	Voltage
230	G.E.	MD109.5	475	500 ser.
175	G.E.	MDS109.5	475	230 ser.
130	G.E.	CO 1812	550	230 ser.
140	West.	MC 90	500	500 ser.
100	G.E.	MD 108	550	230 ser.
100	G.E.	DLC	575	110 cpd.
60	G.E.	CO 2507	600	230 ser.

Also large number of smaller motors.

MOORHEAD-REITMEYER CO. INC., Pittsburgh 19, Pa.

BOILERS

Complete Power Plant consisting of:

7— 500 HP Heine Boilers, 210# pressure.

4— 768 HP Sterling Boilers, 210# pressure.

2—1040 HP Heine Boilers, 210# pressure.

The above boilers complete with super heater, soot blowers, including pulverized fuel equipment, heaters and auxiliaries, and 2—12,500 KW General Electric, 3-60-6600 Turbines with surface condensers, all auxiliaries, designed for extraction. The above plant is ready for immediate shipment and is in excellent condition.

ENGINE GENERATOR SETS

1—150 KW Skinner Uniflow Engine Generator Set A.C.
1—1060—KVA Nordberg Uniflow Engine Generator.

TURBINES

2—5000 KW Westinghouse 3600 RPM 3-60-2300 volts Condenser, all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
15,000 KVA Westinghouse turbine, condenser.
1—250 KVA Waite Turbine either condensing or non-condensing.

DIESEL ENGINES

1—200 K.W. Fairbanks-Morse Full Diesel Engine Generator.
1—200 KW Fairbanks-Morse Full Diesel.
1—350 KW Busch Sulzer 3-60-2300 Volt, all auxiliaries.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
1250 KVA Nelesco engine generator.

ENGINE GENERATOR SETS

1—500 KW Non Releasing Corliss, 3-60-240 volts.
2—400 KW Skinner Uniflow, 3-60-440 volts.
1—625 KVA Bates Corliss engine.
1—10' diameter by 140' high Self Supporting Stack.

MISCELLANEOUS

90,000 pound Cochrane Hot Process Lime & Soda Softener.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
2—6 Retort Taylor Stokers. First-Class condition.
2—300 HP Westinghouse Underfeed Stokers, rebuilt.
1—800 HP Hoppes open feedwater heater.
2—75 HP Elliott Geared 900 rpm turbines 385# steam pressure.
1—232 GPM Centrifugal Boiler Feed Pump, turbine driven, 1200 ft. head.

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325 Fincastle Building — LOUISVILLE, KY.

11000 FT. SUR. COND.

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4000 K.V.A. COND.—NON COND. TURBO

2—4166 GPM. 162' hd. Cent. Pumps (Prac. NEW)

1—36000-25000 GPM. 27'-40' hd. Cent. Pumps

Lot—20" and 24" Valves—Ells—Tees—(Prac. NEW)

1—1500 CFM 2 Stage Aircomp. 275 HP. 60 Cy. 2200 V. Syn. Motor

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IMMEDIATE DELIVERY

PUMPS

One Quimby 4 stage Centrifugal pump direct connected to 75 H.P. G.E. motor—220 volts—3 phase, 60 cycle, 1750 R.P.M.—500 G.P.M. 150 lbs. pressure.

One American Well 2 stage Centrifugal pump direct connected to 30 H.P. G.E. motor, 220 v., 3 ph., 60 cy., 1750 R.P.M. 200 ft. head complete with magnetic starter and safety switch.

FEED WATER HEATERS

One Goubert feed water heater with brass tubes —330 sq. ft. heating surface.

One Cochrane feed water heater, 54" dia. x 48' long—1000 H.P. capacity

BOILERS

One 444 H.P. Union Iron Works, water tube steam boiler 200 lb. working pressure, pulverized coal or oil fired.

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40 H.P. Nagle vertical steam engine, Class F, 12" cylinder, 12" stroke, flywheel 54" x 12½".

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36" dia x 9'3" over all ht. A.S.M.E. design for 40 lbs working press. per sq. inch. Used for short time with High Pressure boiler. Excel. condition. Drwgs. avail. on request.

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29" dia x 11'0" face to face tube sheets,—brass tubes, C.I. heads, steel shells—Complete with Worthington Pumps. Excellent condition.

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Peabody Oil Burner available. Never used.

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2—1200 HP, 6 Cyl., Nelseco M.A.N. Design, 4 cy., 300 RPM.
3—2350 HP, 10 Cyl., Nelseco M.A.N. Design, 4 cy., 300 RPM.
6—2350 HP, 6 Cyl., Busch Sulzer, 2 cy., 300 RPM.

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Fairbanks-Morse model 32-D-14 full Diesel engine, 4 cylinder, vertical 280 H.P., 300 R.P.M., direct connected to Fairbanks-Morse 186 K.W. alternator, P.F. .8, 480 volts, 3 phase, 60 cycles. Direct connected exciter, switchboard and starting equipment.

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2—Erie water tube boilers, 405 HP each, located at Brownsville, Pennsylvania

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Still erected, complete with stokers, water heaters, pumps, valves and fittings, last pressure allowed 160#.

Can quote bargain prices. Must be moved at once.

Can furnish new and guaranteed used pipe, valves, fittings, wood and steel tanks and steel buildings.

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NATIONAL STOCK YARDS

St. Clair County, Illinois

Four Worthington Steam Pumps

14x8½x10 - 14x7x10 - 7½x5x12
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2500 KVA Westinghouse, 3/60/600, direct connected to Westinghouse Steam Turbine condensing type, 200 lb. steam pressure, with exciters, all fittings & switchboard. COMPLETE UNIT.

COMPRESSORS

526 CFM Ingersoll Rand, Style "J"
940 CFM Ingersoll Rand Type 10 hor. 2 st. steam driven, with receiver.
599 CFM Ingersoll Rand type XB10 M.D. with 100 H.P. 3/60/440 motor.

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320-B, 6½-yd. Electric Stripping.

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60,000 gallon Water Tank on 89'9" tower with 10" riser pipe.

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FAIRBANKS 6 CYL.

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Complete with Enco oil burning equipment, pumps, heaters, etc.
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Huber overfeed natural draft, heavy duty. Suitable 350-500 H.P. boiler. Brand new. Immediate delivery. No priority.

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ALL SIZES-TYPES

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BUSINESS ESTABLISHED 1898

1—440 HP Elec. Machinery, 3-60-440V, 900 RPM, two bearing syn. motor
1—400 HP Westinghouse, type CW, 3 ph. 60 cy. 440V, 450 RPM slip ring motor
1—300 HP General Electric, 3 phase, 60 cycle, 440 volt, 360 RPM, type Mt 412 slip ring motor
1—275 HP Allis-Chalmers, 3 phase, 50 cycle, 440 volt, 1175 RPM slip ring motor
1—200 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1150 RPM slip ring motor
1—200 HP Westinghouse, 3-60-2200V, 600 RPM syn. #4956114, direct conn. exciter & starter
2—100 HP General Electric, type I, form K, 3-60-220V 575 RPM
1—100 HP Westingrouse, type CCL, 3 ph. 60 cy. 2200 V, 1750 RPM, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy. 220V, 580 RPM slip ring
1—100 HP General Electric 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter
1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage
4—75 HP G. E. 3-60-2300V, 400 RPM, type I, sq. cage
1—75 HP General Electric, 3 phase, 60 cycle, 440 volt, 450 RPM, type I, form M, slip ring motor
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring
1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type IQ, 3 ph, 60 cy, 3 phase, 440V, 600 RPM Squirrel Cage
2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors
1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage, 900 RPM
1—50 KW factory built m-g set, 125 Volt, Ideal 900 RPM, driven by 75 HP. sq. cage 220/440 V. motor
1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K
1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring
1—60 HP General Electric, 3 phase, 60 cycle, 440 volt, 600 RPM, type MT 556 slip ring motor
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage
2—50 HP Allis-Chalmers, 3-60-440V, 890 RPM slip ring
1—50 HP General Electric, 3-60-440V, 690 RPM, MT 546, slip ring
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage
1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM Sq. Cage
1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring
1—45 KVA Fairbanks-Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator
2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 2220V, 3600 RPM, type HO, frame 12B ball bearing
1—50 KW, Allis-Chalmers, factory-built, 3 bearing M-G set, 125 volt DC, driven by 75 HP, 3 phase, 60 cycle, 220 volt, 1165 RPM motor
2—175 HP, 230V, DC Westinghouse, type SK, 550 RPM
1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM
1—60 HP Westinghouse, type SKI40L, 115V, 1150 RPM vertical
1—50 HP Westinghouse SK200, 230V, 250/900 RPM

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1—1250 KW. 480 V. Cond.
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1—750 KW. 600 V. Cond.
1—500 KW. 125 V. D.C.
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1—200 KW. 2300 V. Cond.
1—120 KW. 440 V. Von. C.
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2—480 H.P. 225#
1—305 H.P. 185# Stoker
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1—168 H.P. 150# Oil
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1—750 GPM Fire Pump Steam

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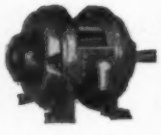

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Qu.	HP	Make	Type	Speed
2	50	G.E.	KT 327	1800
2	100	G.E.	IK	1800
1	150	West.	CS	1800

Slip Ring—220/440 V. 60 cy. 3 ph.

1	40	West	CW	720
1	50	G.E.	I-M	900
1	60	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

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1	25	West.	SK	400/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

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G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3500	140′	Kingsford	Centrif.
2400	55′	American	Centrif.
1100	220′	Allis-Chalm.	Centrif.
1500	160′	De Laval	Centrif.
400	625′	LeCourtenay	Centrif.
250	525′	LeCourtenay	Centrif.
400	350′	Goulds	Triplex
300	500′	Goulds	Triplex
175	500′	Goulds	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
300	150′	Viking	Rotary
1000	460′	Knowles	Steam
750	460′	Snow	Steam
500	460′	Snow	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

M. G. & STEAM DR. SETS

K.W.	Make	Volts	Type
25	Green Eng.	220 D. C.	Beld Drive
100	Ames	240 D. C.	dir. dr. Eng.
75	Ames	240 D. C.	dir. dr. Eng.
17	Sturt. Turbine	110 D. C.	Direct Drive
7½	Sturt. Turbine	110 D. C.	Direct Drive

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100 Northwest	220	1750
25 Roth	230	1750
10 Crock. Wheel	110	925
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Condensation Units, 100 to 250,000EDR

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G.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
140	125	Curtis	Vert. Dup.
125	100	Gardner	Vert. Dup.
28	5000	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

1800	5¼ lbs.	In. Rand	Motor dr.
900	10½ lbs.	In. Rand	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24–45 oz.	Spencer	Motor dr.
250	3.2 lbs.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor dr.

BLOWERS & EXHAUSTERS

C.F.M.	St. Pres.	Make	Type
100–60000	¼"–5"	Buffalo	Various
100–15000	¼"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press	Make	Type
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
500	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Direct dr.
110	15 lbs.	Beach R	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth	Belt dr.
100	high vac	Beach R	Gear dr.
100	27 in.	Deane	Belt dr.
100	29 in.	Devine	Belt dr.

MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
300	G.E.	2300/4000	1800	Syn
150	West.	440	700	CS
125	G.E.	220	1150	Vertical
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	Sl. rg.

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75	900	220/440	G.E.	ITC-5013
x60	350	220/440	G.E.	MT-504Y
52	900	220/440	G.E.	ITC-5012
50	900	200/440	Howell	SR-446
40	1200	220/440	G.E.	MT-336
40	900	220/440	Whse.	CW-658A
40	720	2200	G.E.	MT-346
40	720	440	G.E.	MT-346
35	1200	220/440	Elec. Mach.	SK
30	1750	220/440	G.E.	MT-523
30	1750	220/440	Whse.	CW
30	850	220/440	Watson	KH
30	900	220/440	G.E.	ITC-5011
25	1800	220/440	G.E.	I-M
25	1200	220/440	G.E.	MT-522
25	900	220/440	Watson	KE
25	550	220/440	Watson	KH
20	1800	220/400	G.E.	MT-503
20	1800	220/440	G.E.	MT-336
10	1200	220/440	Whse.	CI-W326Z
10	1200	220/440	Otis Elev.	INT
10	860	220/440	Allis Chal.	ANY

x—Gear head motor.

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4¼ x 5 Ingersoll Rand, 300 PSI, driven by 6 HP, Novo gas engine with 18 x 6 receiver.

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4—150 H.P. HRT boilers, 130# pressure.
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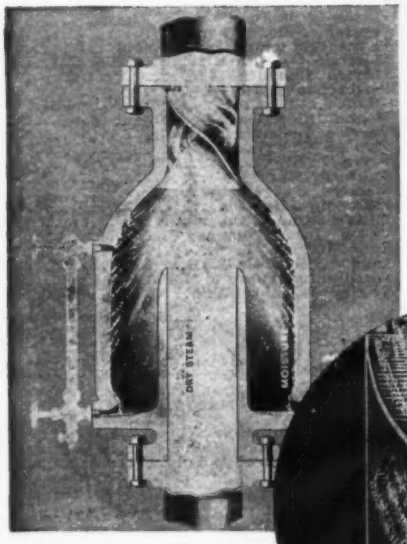
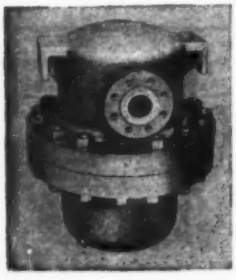
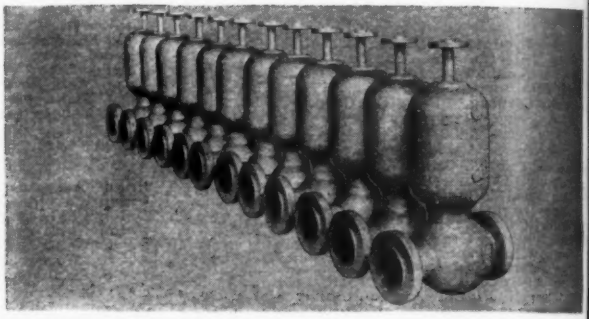
Whirl the costly hazards out of your steam with Swartwout Separators

Positive separation, without pressure loss



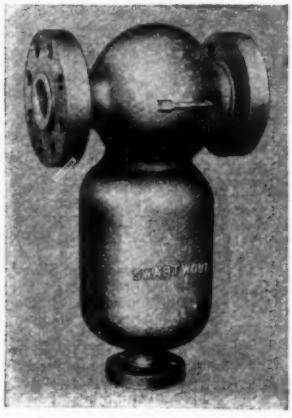


Special Swartwout Separator takes the "water blurp" out of a *steam* whistle. Hot steam is whirled dry—gives the whistle a clear strong blast *immediately.*

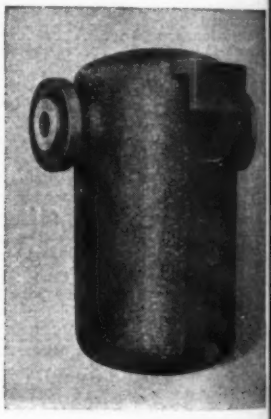


Where dry steam is very essential, these Swartwout high pressure Separators protect auxiliary equipment *aboard ship.*

Nearly five thousand of these Swartwout Loco Separators are in use as *standard* accessories in a special type of equipment where space and weight limitations are important.



Swartwout 900 lb. standard Separator protects high pressure turbine during *wash down period.*

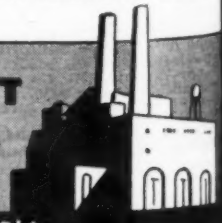


A Swartwout Separator and receiver in cast steel construction, for marine service. Has large storage capacity.

These Swartwout AIR Separators operate on the same principle as the *steam* units. Remove oil and water effectively from compressed air *near the work.*

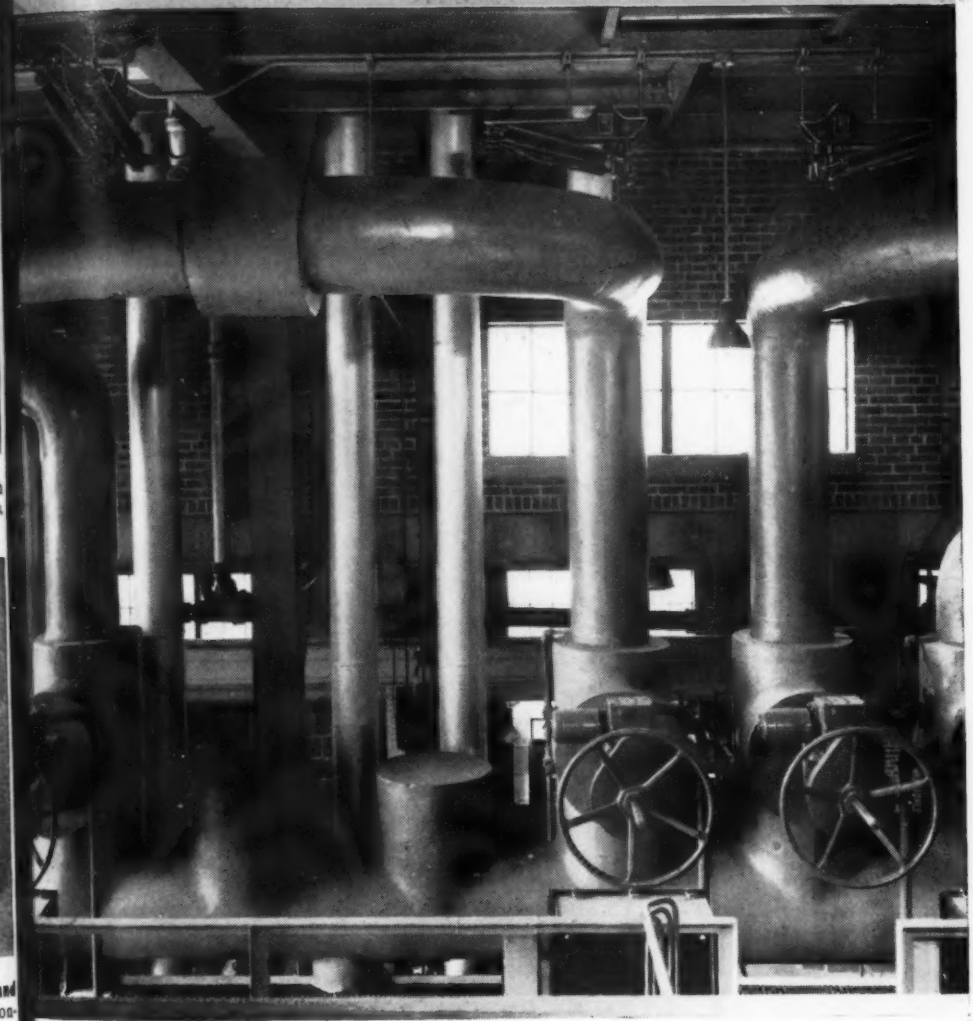
YOU'LL APPRECIATE the *simple, sure* separating action of the *helico-centrifugal principle* used in Swartwout Separators. No slugs of water can slip by to ruin engine or turbine; no dirty oil or grease to spoil work in process. "It's the *whirl* that does the trick." Write today for Separator Bulletin S-14-B.

Swartwout POWER PLANT EQUIPMENT



THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

INTERPRETIVE *Engineering*
EXPERT *Prefabrication*
ENGINEERED *Suspension*



TO USERS of power or process piping GRINNELL service is complete. Included are expert interpretation of piping layouts, modern pipe fabricating equipment and hangers engineered for each specific requirement. You will find it good business to consult Grinnell engineers for assistance on any piping installation.

GRINNELL COMPANY, INC.
Executive Offices, Providence 1, R. I.
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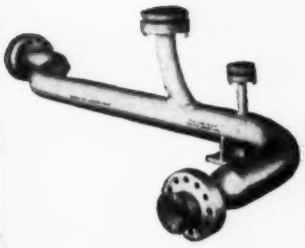
Pipe Fabrication Plants: Providence, R. I. • Atlanta, Ga. • Warren, Ohio

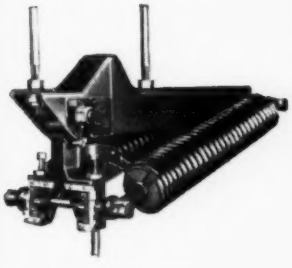
GRINNELL

WHENEVER **PIPING** IS INVOLVED



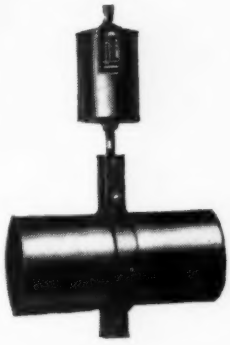
GRINNELL PREFABRICATION

Facilities include every type of modern equipment for the efficient fabrication of piping. Scientific inspection of welds by means of the latest X-Ray and Gamma Ray equipment plus thorough pretesting of the finished pieces assure delivery of Underwriters' Approved sub-assemblies.



GRINNELL CONSTANT-SUPPORT HANGERS

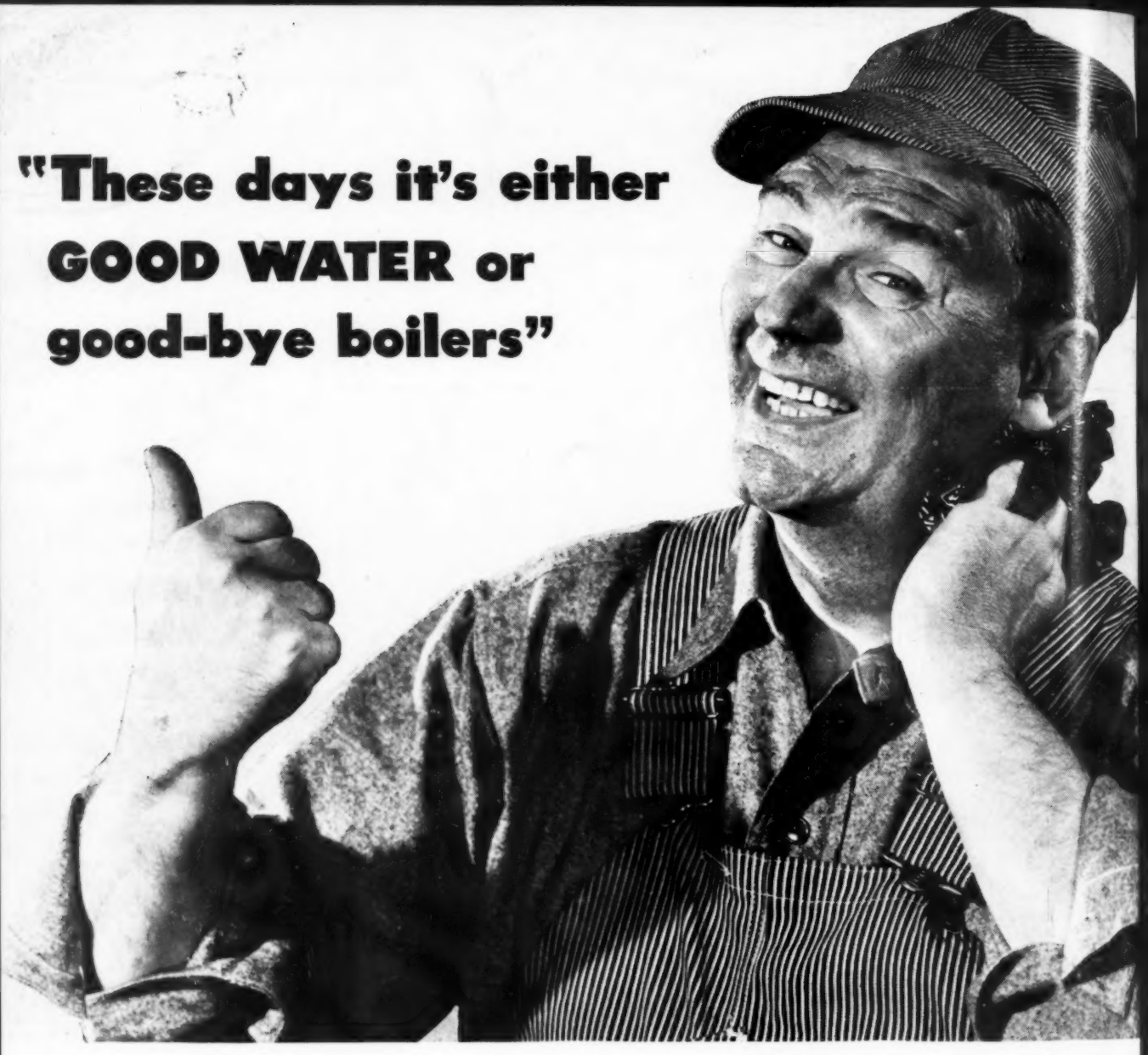
For constant support of piping in all "hot" and "cold" positions . . . full safety factor of the supported system always maintained . . . individually calibrated . . . minimum headroom required.



GRINNELL ENGINEERED SPRING HANGERS

Save engineering time . . . stock hangers for loads ranging from 84 lbs. to 4700 lbs. Change in supporting force of hanger held below 12½% in ½" vertical travel of piping.

"These days it's either GOOD WATER or good-bye boilers"



Permutit prevents scale and corrosion

Under wartime's heavy power loads, impurities in feedwater can be doubly dangerous. Boilers become an easier prey to scale and corrosion, and these trouble-makers mean slowdowns . . . possible shutdowns.

That's why thousands of war plants depend on Permutit.* Good water *prevents* breakdowns, and controlling water quality is Permutit's business. Permutit produces such equipment as the Zeo-Karb* Water Conditioner illustrated, Hot and Cold Lime Soda Softeners, Deaerating Heaters, Continuous Blowoff and Demineralizers that deliver a low-cost substitute for evaporated water.

If your plant is not Permutit-protected, write to The Permutit Co., Dept. A, 330 West 42nd St., New York 18, N. Y. or Permutit Co. of Canada, Ltd., Montreal.

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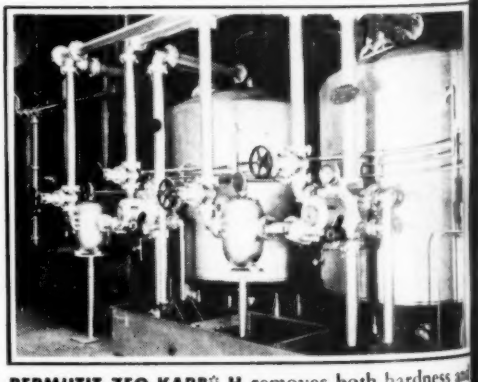

PERMUTIT ZEO-KARB* H removes both hardness and carbonate from water. Effluent contains no encrusta is reduced in total solids. Alkalinity may be adjuste mixing effluents from a Zeo-Karb H unit and a so zeolite unit.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

GOOD WATER
for Industry and
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